TM 55-1268

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

LOCOMOTIVE DIESEL-ELECTRIC

56'/2' GAGE

GENERAL ELECTRIC

23 AND 25 TON, 0-4-0

150 HP, CLASS B-46 / 46-1GE733

AND CLASS B-50 / 50-1GE733

DEPARTMENT OF THE ARMY • *MARCH 1954*

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No. 55-1268

DEPARTMENT OF THE ARMY
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LOCOMOTIVE, DIESEL-ELECTRIC, 56'/2" GAGE GENERAL ELECTRIC 23 AND 25 TON, 0-4-0, 150 HP CLASS B-46/46-IGE733 AND CLASS B-50/50-1 GE733

		Paragraph	Page
CHAPTER 1. GENERAL			
Section I. Introduction			
	Scope	1	5
	References	2	5
	Authorized forms	3	5
II. Description and Data			
	General	4	5
Component data		5	5
CHAPTER 2. OPERATING INSTRUCTIONS			
Section I. Preliminary Instructions			
	Battery	6	7
	Battery switch	7	7
	Control switches	8	7
	Throttle or controller handle	9	7
	Load indicator-service and load-time limits	10	7
	Engine cab ventilation	11	8
II. Preliminary Operation			
	Speed	12	8
	Diesel engines	13	8
	Brakes	14	8
	Leaving the locomotive	15	8
	Water and lubricating oil	16	9
	Lubrication	17	9
	Ventilation of engine compartment	18	9
III. Starting and Stopping			
	Starting the powerplant	19	9
	Stopping the engines	20	10
IV. Operation of the Locomotive			
	Instructions	21	10
	Overheating of engines	22	10
	Operation with one powerplant only	23	10
	Operation with motors cut out	24	11
	Operation of air brakes	25	11
	Moving the locomotive "dead"	26	11
	Compressors and other auxiliary machines	27	11
	Temperature control of cooling water	28	11
	Battery charging equipment	29	11
	Engine starting equipment	30	12
	How power is obtained	31	12
	Main circuits	32	12
	Generator field	33	12
	Precautions	34	12

		Paragraph	Page
Section V.	Simple Troubles		
	Failure to start	35	12
	Failure to move	36	12
VI.	Inspection		
	Regular inspection routine	37	13
	Requirements for each inspection	38	13
	Lubrication during inspection periods	39	13
	Inspection to be made before leaving terminal	40	13
	Inspection upon returning to terminal	41	13
	Inspection every 160 locomotive hours or weekly for 24-hour service	42	14
	Inspection every 680 locomotive hours or monthly for 24-hour service	43	14
	Inspection any overhaul at greater than monthly periods	44	14
Chapter 3.	MAINTENANCE		
Section I.	General		
	Cleaning procedures	45	15
	Lubricating precautions	46	15
	Recommended lubricant	47	15
	Electrical connections	48	15
	Preparing insulation	49	15
	Cable varnish	50	15
	Insulating varnish	51	15
	Inspection of control equipment	52	15
	Running gear and mechanical.	53	15
	Engine and generator mounting	54	16
	Water cooling system	55	17
	Wheel diameters	56	17
II.	Lubrication		
	Diesel engine	57	17
	Generator	58	17
	Motor	59	17
	Air compressor	60	17
	Control	61	18
	Engineer's brake valve	62	18
	Brake cylinder	63	18
	Axle chain	64	18
	Main journals	65	18
	Traction motor gears	66	18
	Center plate	67	18
	Lubricating chart	68	18
III.	High Potential Tests		
	Applying tests	69	19
	Preparation of locomotive for tests	70	19
	Application of test voltage	71	19
IV.	Axle Chain		
	Lubrication	72	20
	Lubricator leads	73	20
	New chains	74	20
	Recommended lubricant	75	20
	Low grade oils harmful	76	2i
	Heavy lubricants	77	20
	Cleaning	78	20
	Idle drives	79	20
	Evidences of good lubrication	80	21
V.	Power Plant and Locomotive Throttle Control		
	Tests and Adjustments		
	Description of powerplant	81	21
	Powerplant operation	82	21
	Powerplant tests at full load	83	21
	Powerplant tests at partial throttle	84	22

		Paragraph	Page
Section	VI. Tractor Generator		
	Description	85	23
	Ventilation	86	23
	Inspection	87	23
	Cleaning	88	23
	Disassembly	89	23
	Care and maintenance	90	24
	Reassembly	91	26
	Testing after repairs	92	26
	Lining up generator with engine	93	26
	Inspection after repairs	94	26
	Maintenance data for type Gt-1503-XI traction generator	95	27
	VII. Traction Motor		
	Inspection and maintenance (traction motor)	96	27
	Frequency of inspection	97	27
	Routine inspection	98	27
	Overhauling	99	28
	Removal of motor armature pinions	100	28
	Mounting of pinions	101	29
	Lubrication -oil	102	30
	Lubrication-grease	103	30
	Care of roller bearings	104	31
	Field coils	105	32
	Brushholders	106	33
	Commutator	107	33
	Armature	108	34
	Balance	109	34
	Testing after repairs	110	34
	Inspection after repairs	111	34
	Maintenance data for type GE-733-H1 motor	112	34
	VIII. Control Equipment		
	Type 17GC5 reversing switch	113	34
	Types 17CM12 and 17CM15 contactors	114	35
	Contact data	115	36
	Operating coil data	116	36
	Interlocks on 17CM contactors	117	36
	DB-1687-C4 relay (VI)	118	37
	17LS8A2 control relay (CR)	119	37
	Resistors	120	38
	Type 17HE8C1 control switch (TC)	121	38
	Inspection and maintenance	122	38
	Type DO instruments	123	38
	IX. Auxiliary Generator		
	Characteristics	124	39
	Inspection	125	39
	Commutator	126	39
	R. Control Unit		
	Voltage control unit	127	41
	Adjustment and tests	128	41
	Cutout relay	129	41
	Voltage regulator	130	42
	Load limitor	131	42
	Trip relay	132	42
	XI. Instructions for Type LX-G Exide Batteries in Diesel Electric Locomotives		
	Charging-regulator settings	133	42
	Readings and records	134	42
	Adding water	135	43
	Keeping battery clean	136	43
	Specific gravity-hydrometer readings	137	43
	Important points	138	43

		Paragraph	Page
Section XII.	Air Compressor Instructions		
	Location	139	44
	Piping	140	44
	Air receiver	141	44
	"V" belt drive	142	44
	Before starting	143	44
	Lubrication	144	44
	Bearing adjustment	145	44
	Valves	146	45
APPENDIX:	REFERENCE		46

CHAPTER

GENERAL

Section I. INTRODUCTION

1. Scope

This technical manual outlines procedures for the necessary inspection and proper maintenance by trained personnel concerned with the operation and maintenance of General Electric 23 and 25 ton, 150 HP, Diesel Electric Locomotive.

2. References

Publications pertinent to the operation and maintenance of dais equipment are listed in the appendix.

3. Authorized Forums

The forms generally applicable in the operation and maintenance of this equipment are listed in the appendix. For a current and complete listing of all forms see SR 310-20-6.

Section II. DESCRIPTION AND DATA

4. General

The locomotive has one Cummins Model HBI-600 Diesel engine nominally rated 150 hp at 1,800 r.p.m. direct connected to a General Electric type GT-1503 direct current, shunt-wound generator. One end of the generator is supported by an antifriction bearing mounted in the frame head and the other end is connected to the engine flywheel by a flexible disc coupling. The complete engine generator set is supported on a subbase mounted on the locomotive underframe. The generator is equipped with a winding which permits it to be used for crankhig the engine by storage battery power. The storage battery power is recharged by an auxiliary generator which is mounted on the engine. This generator also furnishes auxiliary power for lights, controls, and engine starting at a constant potential over the full operating range of engine speed. The locomotive has one General Electric GE-733 direct current, series wound; traction motor. The motor drives through double reduction gearing and is carried in the housing which incloses this gearing. The gear housing is axle mounted and spring supported from the truck frame. The air equipment is straight air, with one engineer's valve, General Electric type S-L1. One brake cylinder is mounted on the underframe, and operates fully equalized brake rigging which applies one shoe to each wheel. A hand brake of the ratchet and drop lever type is provided for holding the locomotive at a standstill. There is one aircooled, single stage, belt-driven, air compressor having a piston displacement of 33 c.f.m. when operating at a speed corresponding to the full load speed of the engine. The capacity of the main air reservoir is approximately 13,000 cubic inches. The locomotive is equipped with a single unit, single station control with the operator's station placed on the right side of the cab. Grouped at this station are the throttle lever, reversing lever, brake valve, sander valve, bell and whistle controls, gage panels and switches for controlling lights. Accessories applied to locomotive include four air-operated sanders, bell, whistle, two headlights, cat) heater, and window wipers.

5. Component Data

a. Locomotive	23 Ton	25 Ton
Manufacturer	General Electric	General Electric,
Classification	B-46/46	B-50/50
Specification	RY 24150A	RY 24160A
Total nominal weight.	46.000 pounds	50,000 pounds

a. Locomotive-Continued

	23 Ton	25 Ton
Traction effort 30 % adhesion.	13,800 pounds	15,000 pounds
Minimum radius of curve.	40'	40'
Gage	56 ½"	56 ½
Maximum permissable speed.	20 m.p.h .	20 m.p.h.
Control _____	Single unit, single station.	Single unit, single station.
Fuel capacity	75 gallon	75 gallon
Lube oil capacity	5 gallon	5 gallon
Cooling system capacity.	11 gallon	11 gallon
Sand box capacity-	380 pounds	680 pounds
Driving coupling	Traction motor to axle.	Traction motor to axle.
Gear ratio _____	19.9:1 Double reduction.	19.9:1 Double reduction.
Height overall _____	10' 7 3/8"	10' 7 3/8"
Length overall	16' 0 ½"	16' 0 ½"
Width overall	8' 5 ½"	8' 5 ½"

b. Engine

	23 Ton	25 Ton
Manufacturer -----	Cummins Diesel Engine Co.	Cummins Diesel Engine Co.
Model ----------	HBI-600 -------	HBI-600
G.E. Specifications--	K6723352AB	
Cylinders	6	6
Bore	4 7/8"	4 7/8"
Stroke	6"	6"
Displacement	672 cubic inches	672 cubic inches
HP rating	150 hp at 1,800 r.p.m.	150 hp at 1,800 r.p.m.
Fuel system	Solid injection	Solid injection

c. Main Generator

Manufacturer	General Electric	General Electric
Type	GT-1503	GT-1503
Volts	230 volts at 1800 r.p.m.	230 volts at 1800 r.p.m.
Amperes	340	340
Weight	940	940

d. Traction Motor Data

Manufacturer -----General Electric		General Electric
Type ----------	GE-733 --------	GE-733
Volts	250	250
Amperes (continuous)	349	349
Weight	2,500 pounds	2,500 pounds

e. Brake Equipment

Manufacturer	NYABCO	NYABCO
Schedule	14-EL	14-EL

f. Wheel Data

Manufacturer -----General Electric-General Electric		
Wheel Arrangement.	0-4-0	0-4-0
Type	Solid Steel	Solid Steel
Diameter	34"	33" or 34"

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. PRELIMINARY INSTRUCTIONS

6. Battery

a. To maintain a satisfactory state of charge in the battery and to realize good battery life, carefully observe the battery company's instructions and instructions on battery heater (when used), paragraphs 133 through 138.

b. An electric meter is provided on a gage panel to allow the engineer to observe that the charging generators are functioning and that the battery is being charged.

c. When a voltmeter is used for this purpose, if the needle is in the first long RED band it indicates that the battery is in bad condition or being discharged. When the needle is in the WHITE band it indicates normal open circuit voltage. The needle in the GREEN band is an indication that the battery is receiving a normal charge. When the needle is in the small RED band beyond the GREEN it indicates that the battery is being over-charged. The engine crew should report to the maintenance man when the voltmeter indicates in the RED band of the dial.

d. An ammeter, when used, also indicates the condition of the battery. Generally the amount of current shown on the charging portion of the dial is proportional to the state of charge of the battery. As the pointer approaches zero the battery gets nearer to fully charged condition. When the pointer is in discharge portion of the dial the battery is delivering instead of receiving current. When this condition exists under normal operation it should be reported to the maintenance man. Neither voltmeter nor ammeter will show the condition of the battery unless the charging voltage for normal operation is at such value as to maintain the battery at proper charge.

e. To protect the battery against discharge and short circuits, the locomotive is shipped with the ground connection removed from the battery. This must be restored before putting the locomotive in service.

7. Battery Switch

a. On locomotives where a cutout switch is provided for disconnecting the battery from the circuits, the switch should always be opened when leaving the locomotive for an idle period. It should also be opened whenever working on any control circuits.

b. If necessary to work on any of the circuits or devices not protected by a cutout switch, the ground should be removed from the battery.

8. Control Switches

To prevent battery discharging, be sure that all switches in circuits for which the battery supplies current are open when leaving the locomotive standing idle.

9. Throttle or Controller Handle

a. To prevent accidental starting of the locomotive always leave the throttle handle or the controller handle in a position which will insure that the traction motors will remain disconnected from the generators whenever the engines are started.

b. Never leave the operating position without first placing the reverser handle in the neutral position. If the reverser handle is the portable type, remove it for further protection.

10. Load Indicator-Service and Load.-Time Limits

a. This locomotive is designed for switching and transfer moves not exceeding one-half hour's continuous duration at full power. The following load-time limits apply only for such service.

b. The locomotive is not intended for railway road work, long transfer or long industrial haulage service. It can be damaged if very heavily loaded for too long a time. Such damage is caused by heating which depends upon the size of the load and the length of time the load is carried.

c. A load indicator, when used, is actually an ammeter with a special dial marked in bands of GREEN, YELLOW, and RED, instead of amperes. The load indicator will enable the operator to avoid damaging the locomotive if the following rules are observed.

(1) GREEN-Operation with the pointer in the green band is unrestricted as long as the locomotive is employed in the service for which it was designed, as described above.

(2) YELLOW-Operation with the pointer in the yellow band should not exceed 1 hour total in any 8-hour period.

(3) RED-Operation with the pointer in the red band should be confined to starting or short movements that are never over 4 minutes at a time. When the pointer is in the red band 2 minutes or more the operation should not be repeated frequently.

d. The total time in the red and yellow bands added together should not exceed 1 hour in any 8-hour period.

e. When starting a train the operator should not hesitate to go into the RED and advance the throttle as far as possible without slipping the wheels. In this way the time in the RED will be kept to a minimum.

11. Engine Cab Ventilation

a. The engine cab doors have no ventilating openings, but are provided with two-position latches so that the doors may be latched open approximately 2 ½ inches, as latched closed,

b. Air for generator ventilation, fob the engine intake, for the air compressor, and for the engine radiator is drawn into the engine cab by the pusher type radiator fan.

c. To make certain at all times that the traction generators receive an ample supply of ventilating air of approximately outdoor temperature, the cab doors immediately adjacent to them should always be latched open when the locomotive is in operation.

d. If additional air is required for the radiators, the remaining cab doors then should be latched open, but only after all of the doors adjacent to the generators have been opened.

Section II. PRELIMINARY OPERATION

12. Speed

Do not operate the locomotive at any higher speed than that given on the locomotive data.

13. Diesel Engines

a. Before starting the engines and before doing any work on them, read the engine instructions, TM 55-1001, to be sure that the engines are in operating condition.

b. While operating the engines, make regular checks of lubricating oil pressures and cooling water temperatures.

c. If the engines become overheated for any reason, never add water to the cooling system, until the engines have cooled off.

d. After pulling heavy loads, allow the engines to idle for a few minutes before stopping them to prevent the danger of boiling the cool- water.

e. When adjustable engine hood hatches are provided these should be opened during warm weather operation.

14. Brakes

a. Never depend upon the air brakes to hold the locomotive on a grade when the compressor are shut down.

b. Before starting the locomotive, make the brakes operate properly and that the air pressure in the reservoir is normal.

c. In emergencies, apply the brakes at one and shut off the power afterwards.

d. Engineers operating the locomotive for the first time should be cautioned to apply the brakes sooner than they would on a steam locomotive in order to stop at a given spot. This is because an electric locomotive has much less friction than a steam locomotive.

15. Leaving the Locomotive

a. Before leaving the locomotive, shut down the engines, open all the switches and see that all doors, windows, and hatches are closed.

b. Close radiator shutters.
c. c. Set the hand brakes.
d. *d.* If there is danger of the engine water freezing, drain the entire cooling system unless antifreeze is used.

16. Water and Lubricating Oil

Before starting the engines be sure the water systems are filled. Also see that each engine is supplied with the proper quantity of suitable lubricating oil.

17. Lubrication

Before starting the engines and before running the locomotive, read the lubrication instructions in LO 55-1001 and LO 55-1268 for the engines compressors, and locomotive to be sure that all parts have been properly lubricated.

18. Ventilation of Engine Compartment

During warm weather operation raise the adjustable hatch-covers on the engine compartment roof, if means for adjustment is provided.

Caution: Do not reach inside the frames of generators or motors while they are in operation. Do not leave tools or any other loose material near the electrical equipment when the locomotive is in operation.

Section III. STARTING AND STOPPING

19. Starting the Powerplant

a. Before attempting to operate the locomotive for the first time, observe all of the foregoing preliminary instructions and the instructions on the engines and other equipment.

b. Close the battery and control switches, or circuit breakers. Also, see that the engine cutout or generator teaser field or exciter field cutout switches are closed (if the locomotive is equipped with such).

c. See that the reverse handle is in neutral position and the throttle handle in idling position. (In cold weather it may be necessary to advance the throttle beyond the idling position to get the engines started.)

d. Start each engine (if more than one) by pushing its starter button and observe that each engine operates properly and that the lubricating oil pressure builds up.

e. Allow the compressors (if more than one) to pump air until the main reservoir gage shows no further increase in pressure. See that the compressors function properly.

f. To pump up air quickly, advance the throttle handle to operate the engines at about three-fourths speed, but first allow the engines to operate at idling speed a sufficient length of time to warm up. Reduce the engine speed to idling when finished pumping up air.

g. Observe the operation of all belt drive machines and other equipment to see that they function properly.

h. Apply the air brakes to see that they operate properly.

i. See that the battery is being charged as indicated by the battery meter.

j. Diesel electric locomotives operating in cold climates are provided with a heater to warm up the engine before starting.

k. The diesel engine has no ignition system and depends upon the heat developed by compression to make it fire. Therefore, after periods of shutdown during cold weather where the engine has cooled down to air temperature, there is danger of completely discharging the battery by continued cranking before the cylinders get warm enough to start. To guard against this condition a kerosene heater is provided for the purpose of warming up the cooling water in the engine jacket.

1. To start the heater make sure that there is sufficient kerosene in the supply tank. Open the valve in the line between the top of the water heater and the engine water jacket. This valve should be closed when the engine is operating. A thermostat shuts off the water circulation to the radiator.

m. To start the heater light the wick and adjust for a clear blue flame. After the heater has warmed up, readjust, if necessary, to avoid smoking.

n. Do not attempt to start the engine until the engine temperature indicator registers at least 60 or 70°.

o. After the engine starts, shut down the heater and close the valve to the engine cooling system.

20. Stopping the Engines

a. To stop the diesel engine move the throttle into the extreme forward position.

b. If the locomotive is provided with engine shutdown rods also pull the button marked "engine shutdown" and hold it until the engine has come to a stop, then open the control switch.

c. On the locomotives equipped with engine cutout switches the engines are stopped by moving the throttle into the extreme forward position and opening the engine cutout switches.

d. If at any time an engine fails to stop under normal conditions, or if it overspeeds, pull the emergency shutoff pull button, or close the shutoff cock, on the side of the fuel pump if the engine is provided with these features.

e. If the throttle valve should stick in Open position close it by hand.

Section IV. OPERATION OF THE LOCOMOTIVE

21. Instructions

a. It is assumed that the locomotive has been made ready to operate in accordance with the foregoing instructions and that the engines are operating and the main reservoir is fully charged.

b. If at any time it is impossible to remove power from the traction motors by shutting off the throttle, the control switch or circuit breaker switch should be opened.

c. Before attempting to start the locomotive be sure that the handbrake is released. Move the reverser handle to forward or reverse position as desired. When the throttle handle is then advanced certain control circuits are energized which close the line contactors and established connection between the traction motors and generators. Increased current through the traction motors, or acceleration of the locomotive then is obtained by advancing the throttle handle. Shunting connections, when used, of the traction motor fields and parallel connection of the motors, when used, are automatically established at the proper point.

d. In order to change the direction of motion of the locomotive, the throttle handle should be placed in position for idling the engines and the locomotive brought to a stop before advancing the throttle again. Never reverse the locomotive while in motion except in cases of extreme emergency.

e. When there is a tendency for the wheels to slip, sand the rails and close the throttle slightly until the wheels stop slipping. In case the wheels lose their grip entirely and spin, it is usually necessary to move the throttle into idling position before the wheels take hold.

f. When coming to rest on a grade, apply the brakes on the locomotive before closing the throttle handle. Likewise, when starting on an ascending grade, do not release the brake of the locomotive until the throttle handle has been opened to a sufficient amount to prevent the train or locomotive, from drifting backward.

g. If the current fails on the locomotive, for any reason, close the throttle handle and, if on a grade, apply the brakes.

h. Do not operate the locomotive at higher speed than 20 m.p.h.

22. Overheating of Engines

a. Do not stop the engines immediately after a hard run. Circulation of the water depends upon the circulating pump and when the engines are shut down, the pumps stop. The iron masses in an engine pulling full load absorb sufficient heat to boil the water if the circulation stops. Let the engine idle for five minutes before shutting engines down.

b. If for any reason the water supply has failed, do not turn water into the cylinders until they have become normally cool. The cylinder heads are likely to crack if water is turned into them when they have become too hot.

23. Operation With One Powerplant Only

a. Locomotives equipped with more than one power plant may be operated at any time with one power plant simply by leaving the other power plant shut down and opening the respective exciter field or generator teaser field cutout switches (when such are used).

b. Be sure to take proper precautions to prevent water in the shutdown engines from freezing.

24. Operation With Motors Cut Out

In case of trouble, making it necessary to cut out a traction motor on locomotives provided with this feature, open the motor cutout switch for the defective motor or motors, or if the switch is of the double-throw type place it in the motor cutout position. (The motors are numbered from the end of the locomotive marked "F".) With motors cut out take special care to avoid pulling heavy loads or operating with full open throttle.

25. Operation of Air Brakes

For operation of air brakes refer to TM 55-2022.

26. Moving the Locomotive "Dead"

a. When the locomotive is hauled "dead" in a train, open all switches or circuit breakers, including the battery cut-out switch. When the air brake dead-engine fixture is used, set as described in TM 55-2022.

b. If the haul is long, or the train speed exceeds the maximum safe speed of the locomotive, remove the pinions from the traction motors. (See par. 100.)

27. Compressors and Other Auxiliary Machines

The compressors and other auxiliary machines are driven by "V" belts from the engine crank shaft or generator. Adjustment of the belt-tension is provided for by moving these machines on their bases so as to change the distance between pulley centers. A fairly accurate guide for determining the correct tension on the belts is to make the adjustment so that the belts can be depressed about 1 inch at a point midway between the pulleys.

28. Temperature Control of Cooling Water

a. When automatic control of the radiator fans is used a thermostat maintains the cooling water temperature at approximately 150° F. to 170° F. by starting and stopping of the fans through the action of a magnetic clutch controlled by the thermostat, provided the radiator shutters are in the correct position. A hand operated switch connected across the thermostat permits manual control of the radiator fan when the water temperature is below the setting of the thermostat.

b. Diesel engines that have the fans belted directly to the engines are provided with a thermostat in the cooling water outlet which permits the water to circulate through the engine cylinder block and shuts it off from the radiator when the temperature of the water in the engine is below that for which the thermostat is set.

c. During cold weather it may be necessary to partly or entirely close the shutters in front of the radiators in order to maintain the proper temperature. During extremely cold weather if it becomes difficult to maintain engine temperature at the proper value the shutters in the sidedoors may be partly, or entirely, closed, especially on the windy side of the locomotive. (For normal operation these shutters should be open.) When the engines are shut down during cold weather close all shutters entirely.

d. The control levers in the operating cab are marked to show the position of the radiator shutters.

e. Difficult operation of shutters is likely caused by lack of lubrication at the hinge pins of the vanes and at the operating lever pin joints. Use a light oil to lubricate, especially during cold weather.

29. Battery Charging Equipment

a. In general, the function of the auxiliary generators, or charging generators, is to supply the control and the lighting load and also to charge the batteries. On locomotives with more than one powerplant, the generators are connected in parallel for battery charging.

b. When using belt-driven auxiliary generator the battery charging equipment for each power plant consists of a General Electric auxiliary generator, belt driven from the main generator or engine, a General Electric voltage regulator, and a General Electric reverse current relay.

c. When mounted on the engines the battery charging equipment for each power plant consists of a Leece-Neville generator mounted on the engine and driven there from by gearing; also a Leece-Neville voltage regulator and reverse current delay.

30. Engine Starting Equipment

In this type of starting the traction generator is used as a motor. To facilitate starting without excessive drain on the battery the generator is provided with a series field winding.

31. How Power is Obtained

a. The engine supplies mechanical power to the generator which is converted to electrical power for the traction motors and auxiliaries. Each engine and its respective generator is at all times electrically as well as mechanically an independent power plant unit, there being as many such independent units as there are engine-generator sets.

b. The control is so arranged that opening the throttle at the operator's position increases the speed of the engine, or engines. This increases the power furnished the generator which furnishes the power for the traction motors. On locomotives with more than one power plant, the throttle adjustment should be maintained so that each engine, when in good condition takes its proper share of the load.

32. Main Circuit

a. The main circuits for each power plant include the following equipment: Propulsion generator, traction motors, contactons for connecting the propulsion generator and traction motors, and reverser switch for changing the direction of current in the traction motor fields, or contactors for changing direction of current in the traction motor armatures.

b. Across the traction motor field is connected a field shunting resistance which is uses' for weak field operation at the higher locomotive speeds in order to obtain maximum engine utilization over a wide range of locomotive speeds. On some types of locomotives, maximum engine utilization is obtained by automatic series-parallel connection of the motors instead of shunting the field winding.

33. Generator Field

a. When connected for separate excitation the shunt field is supplied with current furnished by a belt-driven exciter. This exciter enables the generator to deliver the full output of the engine over a wide range of current.

b. When connected for self-excitation the shunt field is supplied with current furnished by the generator itself, but may also receive part of its exciting current from the battery depending on the scheme of connections.

34. Precautions

Do not leave the locomotive unless the engines are shut down. See that the battery cutout switch and control switch or circuit breaker are open. Close all windows and doors. Set the handbrake.

Section V. SIMPLE TROUBLES

35. Failure to Start

(fig. 34)

If the engine fails to turn over when the starting button is pressed

a. Make sure the battery and control switches are closed.

b. See that the starting contactor GS1 closes.

c. If the starting contactor does not close check battery and control fuses; replace if blown. If the battery voltmeter reads this is an indication that the battery fuse is not blown.

d. If the starting contactor still does not close, check for open circuit at starting button, the operating coil of the starting contactor or at the control switch.

e. If the starting contactor closes, but the engine does not turn over, the starting contactor connections may be defective, or the battery is probably discharged and should be recharged from an outside source.

f. If the battery is not discharged and the engine still cannot be started, the generator is probably at fault, the most likely trouble being poor ground connection or burned out or loose connections in the main circuit.

g. If the engine turns over but fails to "fire" refer to TM 55-1001.

36. Failure to Move

If the engine starts, but the locomotive does not move, in the first position of the throttle –

a. See that the line contactor S1 closes.

b. If the line contactor does not close look for poor connections at starting contactor interlock, throttle control switch, or at line contactor operating coil connection.

c. If the contactor does close, but still the locomotive does not move see that the brakes are released.

d. See that the reverser is set in proper position and that. contacts are in good condition. If none of these remedies the trouble

e. Obtain a voltmeter and check the generator voltage to see that it builds up. If it does not build up, there is probably an open circuit in the generator shunt field winding.

f. If the battery does not charge, check the fuse in the auxiliary generator circuit and replace if blown.

Section VI. INSPECTION

37. Regular Inspection Routine

Establish regular inspection routine for each locomotive. Certain parts should be inspected once for each shift or at least once every *24* hours. Make further inspection at less frequent intervals.

38. Requirement for Each Inspection

The requirements for each inspection will be, to a great extent, self-apparent to men familiar with locomotive maintenance. To assist new men in this work, the following outlines cover the more important items. At the inspection period correct any defects observed during operation, if not corrected at the time of occurrence.

39. Lubrication During Inspection Periods

Lubricate as required during inspection periods. For a schedule of lubrication, refer to LO 55-1001 and LO 55-1268.

40. Inspection To Be Made Before Leaving Terminal

a. Check radiators for proper height of cooling water.

b. See that lubricating oil in the engine crank case or in the lubricating oil reservoirs is at the proper height.

c. Start each engine and see that it operates properly. Check the lubricating oil pressure.

d. See that the air compressors operate properly and that the oil level is at the proper height. Also check the pilot valve or governor adjustment by noting the pressures at which the compressors cut in and out. Readjust if necessary.

e. Examine the radiator fans to see that they function correctly.

f. Check the traction motor blowers for proper operation.

g. Operate the air brakes and see that they function properly.

h. Apply the brakes and open the throttle handle or controller handle, slightly for each direction of motion to determine that power is obtained.

i. Check battery charging by noting if the electrical meter in the battery circuit shows CHARGE.

j. Check all auxiliary circuits for blown fuses and lamp circuits for defective lamps.

k. See that the sand boxes, are filled and that the sanders operate.

41. Inspection Upon Returning to Terminal

When a locomotive arrives at an inspections terminal at the end of a shift, a complete inspection of the entire locomotive should be made as soon as possible after the crew has left the locomotive. This inspection should include the following

a. Check items listed in paragraph 40.

b. Investigate any defects or difficulties reported by the crew and make necessary corrections.

c. See that all lubrication to be applied daily is attended to. Certain parts such as pedestal shoes should not be lubricated until immediately before leaving the terminal.

d. Check the brake cylinder piston travel and replace any broken or badly worn brake shoes.

e. For engine inspection refer to TM 55-1001.

42. Inspection Every 160 Locomotive Hours or Weekly for 24-Hour Service

a. Engines. For engine inspection see TM *55-1001.*

b. Generators. Grease the generator bearings if required. See LO *55-1268.*

c. Traction Motors. Grease the traction motor bearings if required. See LO *55-1268.*

d. Auxiliary Apparatus. Lubricate the auxiliary equipment; bearings such as radiator Fans and traction motor blowers if required. gee LO *55-1001* and LO *55-1268.*

*e. Locomotive Journals and Motor Axle Bear*ings. Inspect for proper lubrication and add oil if necessary. See LO *55-1268.*

f. Gears. Inspect the traction motor gears to determine if they receive sufficient lubrication. Add lubricant if necessary.

43. Inspection Every 680 Locomotive Hours or Monthly for 24 Hour-Service

a. Cooling Water System. Drain the entire cooling system, flush to remove sediment and refill with clean water. If an antifreeze solution is used, replace after the system has been flushed out. Take care to have the proper proportion to prevent freezing.

b. Engines. For engine inspection and maintenance see TM *55-1001.*

c. Generators. Examine the commutator, armature clearance, fields, brushes and brushholders, tension on brushes and generator leads and bus rings. Blow out with clean dry air.

d. Traction Motors. Examine the commutators, armature clearances, fields, brushes and brushholders, tension on brushes and motor leads. Blow out with clean, dry air.

e. Contactors and Relays. Examine for loose connections or worn parts. Examine the tension on the fingers of the interlocks. Inspect the contactor tips and arc chutes and renew any that are badly burned. Blow out control equipment with clean, dry air. Examine controllers; clean the fingers and inspect the wire connections. Inspect all hand switches for loose or broken parts.

f. Battery. Clean out the battery compart
ment. Clean the battery and its terminals and apply vaseline to terminals to prevent corrosion. Check height of electrolyte.

g. Running Gear. Inspect the running gear for loose bolts especially on axle caps and gearcases. Inspect the wheels, brake shoes and brake rigging. Oil the truck centerplates.

h. Throttle. Operate the throttle handle and observe that the system works freely without binding and without excessive looseness resulting from wear. See that all bolts in supports and adjustable levers are tight. Place the throttle handle in the full throttle positions and see that the fuel control lever on the diesel engine fuel pump is tight against the full fuel stop. If the locomotive has a hydraulic throttle, lack of sufficient movement may be caused by

(1) the spring in the spring barrel being compressed, if so, extend the throttle rod by hand; or
(2) air in the lines, in which case the system should be vented.

i. Wiring Circuits. See that there are no loose, broken, or high resistance connections in the control wiring circuits. Check the throttle switch for correct setting. Make sure the contacts are in good condition and are making and breaking properly.

44. Inspection and Overhaul at Greater Than Monthly Periods

a. At least twice a year drain and clean the fuel oil tanks.
b. At least once a year, or more often if experience proves necessary, inspect, clean and repair

(1) Gears and pinions, and other driving parts.

(2) Journal bearings, motor axle bearings, journal boxes, wearing plates on journal boxes and frame pedestals.

(3) Motor nose suspension.

(4) Wheel treads.

(5) Center plates (if equipped with such).

(6) Brake rigging and air brake equipment. Refer to air brake instruction in TM *55-2022.*

CHAPTER 3

MAINTENANCE

Section 1. GENERAL

45. Cleaning Procedures

Maximum service can be obtained from electric machinery only when it is kept dry and clean. This is especially true when copper dust, brake shoe dust, or other metallic matter may collect in or about the apparatus. All apparatus should be blown out, using dry compressed air, and parts accessible should be wiped off with clean wiping rags. Washed wiping rags are preferable to cotton waste as they are less likely to leave lint. When using air for cleaning in the vicinity of exposed mica insulation, take care not to use too high pressure as small flakes of mica will be blown off, finally resulting in complete destruction of the insulation.

46. Lubricating Precautions

Oil is very destructive to insulating materials as it collects dust and dirt, causing them to break down electrically. When lubricating apparatus take extreme care to prevent the lubricant from getting on insulated parts, and if any does get on it, wipe thoroughly with clean wiping rags.

47. Recommended Lubricant

G-E PC Control Lubricant No. 1 is recommended for use where lubricants are necessary on control equipment, except on cylinder walls and leather packing of the air engines for which G-E PC Control Lubricant No. 2 is recommended.

48. Electrical Connections

All screws, bolts, and nuts which secure electrical connections should be kept tight to insure good contact. When making a ground connection the surface to which connection is to be made should be thoroughly cleaned of all dirt, paint, or rust to assure good electrical contact.

49. Repairing Insulation

Cement may be used to advantage in repairing burned insulation such as arc chutes, sides of contactors, and switches. One of these that has been used with considerable success is G-E No. 12-G compound. Another good cement is Sauereisen INSA-LUTE high temperature cement No. 7 or equivalent.

50. Cable Varnish

Glyptal No. 1201 varnish is recommended for all cables exposed to dirt or moisture, especially where creepage is important. It has high insulating qualities and gives a smooth surface which is easily cleaned.

51. Insulating Varnish

When painting control apparatus, use a good quality of insulating varnish such as G-E No. 458 or Glyptal No. 1201 varnish.

52. Inspection of Control Equipment

During inspection of control equipment watch for the following

a. Loose nuts and screws.

b. Cotter pins missing or not split.

c. Broken or weak springs.

d. Weak contact pressure on interlocks and relay contacts and improper wipe and break.

e. Grease and dirt on insulating materials.

f. Worn or burned contactors.

g. Loose terminals and connections.

h. Broken insulators.

53. Running Gear and Mechanism

Inspect the trucks and other parts of the running gear equipment as frequently as service conditions require, for loose or missing bolts and nuts, worn wearing plates, worn or broken bearings, defective gears and gear cases, and broken springs. This inspection should include the following parts

a. Gears and gear cases.

b. Motor axle caps and supporting bolts, nuts, and linings.

c. Motor armature bearings.

d. Motor nose suspension bolts, springs, safety lugs, and hangers.

e. Intermediate gear bearings.

f. Universal joints and driving shafts.

g. Driving chain.

h. Journal boxes, their wearing plates and bearings.

i. Pedestal wearing plates.

j. Equalizers and springs.

k. Dust guards.

l. Thrust plates at end of axles.

m. Crank arms and pins.

n. Side rods and their bearings.

o. Wheels and tires.

p. Hub liners.

q. Center plates and side bearings.

r. Brake rigging, including cylinders, levers, hangers, pins, brake shoes, brake shoe heads and turnbuckles.

s. Traction motor air ducts.

t. Sander hose and pipes.

u. Couplers.

v. Motor leads and supporting clamps.

w. Air brake hoses.

54. Engine and Generator Mounting

a. The most common design used in connecting the engine and generator is to bolt the generator frame to the engine. This bolted connection and the connection of the flexible couplings are rabbet fits which give correct alignment of the coupling and a properly equalized air gap.

b. The set is supported by three-point suspension, one on each side of the generator and one at the fan-end of the engine, on a common subbase. Rubber pads are used under the generator supports, the fan-end being rigidly bolted to the support on the subbase. The subbase is fastened to the locomotive platform by bolts.

c. Longitudinal movement of the set is restricted to a total of about .016 in. (.008 in. on each side) by blocks welded to the generator supports. This clearance should be checked occasionally during service to see that it does not become excessive.

d. On locomotives using the Caterpillar type of engine the subbase is omitted, the engine generator set being bolted directly to supports welded to the cab-platform. Rubberized fabric is used for cushions under the supports of the fan-end, but considerably less cushioning is used under the generator supports. On this type of mounting allowance is made for a lateral movement of about 1/32 inch total (;64 inch on each side) at the fan-end of the set. The longitudinal movement is restricted to about .006 inch (.003 inch on each side) total, by blocks welded to the generator support. Check these clearances during service to see that they do not become excessive.

e. On locomotives where the generator frame is not bolted directly to the engine the engine and generator are mounted on a common base and strips of cork are laid on the floor plate under the engine-generator base. The base is held in place by bolts having coil springs under the nuts to equalize the pressure on the subbase. Longitudinal movement of the engine-generator set is prevented by blocks welded f.:> the platform at the ends of the subbase.

f. Alinement of the generator and engine through the flexible coupling is obtained by shims under the generator supports. In this method of mounting there are two conditions to fulfill-correct alinement of the coupling and equalization of the generator air-gaps; changing one is very apt to affect the other.

g. After the correct alinement has been obtained the generator is doweled to the subbase. This facilitates realinement of the coupling and generator frame if the original alinement has been disturbed for any reason. However, the dowel pins should not be entirely depended upon for locating the generator frame as the engine may have been shifted on the base. The coupling therefore should be checked with a dial gage and the air gap measured to make sure that realinement is correctly made.

h. On locomotives using Cooper-Bessemer engines the generator armature and engine crankshaft are bolted together rigidly, that is, flexible couplings are not used. The engine and generator-frame are mounted on a common

base and equalization of the generator airgap and the correct alignement of the engine crankshaft with the generator armature shaft are obtained by the use of shims under the generator supports.

i. If it becomes necessary to disconnect the generator from the engine or do any work that would disturb the alinement when reassembling the set, take care to see that all of the shims under the generator supports are replaced in the same position as found. Also see that the dowel pins or body-bound bolts are properly replaced.

j. However, inserting the dowel pins or body bound bolts, in the generator frame support, and reinstalling the same thickness of shims as used before disturbing the alignement does not insure correct setting as the engine may have been moved on the subbase. To insure that the engine is located in exactly the same position as it was before disturbing the alinement, always insert the dowel pins or the body-bound bolts in the engine base before trying to align the generator.

k. The engine generator set sub-base is mounted on the locomotive deck-plate on strips of cork laid on the deck-plate under the subbase. The base is held in place by bolts with the coil springs to equalize the pressure on the subbase. Longitudinal movement of the enginegenerator set is prevented by blocks and wedges welded to the deck-plate at the ends of the subbase.

55. Water Cooling System

An open circulating system is used to cool each engine. A centrifugal pump circulates the water through the engine cooling water jacket, then through the radiators back to the pump.

a. Filling and Draining Water System.

(1) Before filling the systems be sure that the drain valves and drain cocks are closed. Use only clean water and fill through pipes located on the top of the radiators or through the pipes located along the side of the locomotive.

(2) Replenish the water supply as required to make up the loss from leakage and evaporation.

(3) To drain the water cooling system, open all drain valves and shutoff valves wherever they occur in the water piping. Make certain that all parts of the system, including engine block and any water-cooled auxiliaries are drained. Refer to TM 55-1001.

b. Replacement Water. Drain the water in the system completely every month. As makeup water is added from time to time, the concentration of the impurities in the water becomes greater. To keep the concentration from getting too strong, the water must be changed completely.

56. Wheel Diameters

Keep the wheel diameter variation within limits given in the locomotive data to avoid too much unbalance in load between the motors. However, it is recommended that the wheel diameters be maintained as nearly equal as railroad shop practice permits.

Section 11. LUBRICATION

Note. For lubrication instructions refer to SR 31020-4 for applicable lubrication order.

57. Diesel Engine

See engine instructions, TM-1001 and LO 55-1001.

58. Generator

See maintenance of generator and TM 55-405.

59. Motor

See maintenance of motor and TM 55-405.

60. Air Compressor

Keep oil in the crank case at level shown on the bayonet gage which is located in one corner of the crank case. Use the same grade of oil as in the diesel engine crank case or use a regular air compressor oil.

61. Control

See maintenance of control.

62. Engineer's Brake Valve

The best lubricant for the engineer's valve is a good grade of graphite grease which should be applied very sparingly when the valve is taken apart for cleaning. If necessary, a good grade of oil may be applied through the oil hole which has a pipe plug in it. However, this should be done only when not convenient to tike the valve apart and the oil must be applied *very* sparingly.

63. Brake Cylinder

See TM 55-2022.

64. Axle Chain

When used, refer to LO 55-1268.

65. Main Journals

a. For antifriction bearing journals for locomotives using this type of bearing journals, see LO 55-1268.

b . Waste-packed bearing journals

(1) On locomotives where waste is used in connection with lubrication, pack the journal boxes as frequently as service conditions require.

(2) Use a good grade of wool waste soaked for at least 24 hours in Galena car oil or its equivalent, and drained for about 6 hours. The temperature of the *oil* and room in which the waste is drained should be about 60° F.

(3) A roll of drained waste (A, fig. 2) should be packed tightly half-way around the journal at the back end and bottom of the box as shown. Place packing (B, fig. 2) in position with moderate pressure against the journal but sufficient to maintain good contact; apply the waste somewhat looser at the sides of the box to prevent wiping effect. The packing should not extend higher than the center of the journal.

(4) After packing is completed, pour free oil over the waste along the sides of the box near the center. Place a wad of semidry waste (C, fig. 2) between the end of the journal and front end of the box shown, to serve as a dirt collector. This waste can easily be renewed as required.

66. Traction Motor Gears

a,. Single Reduction Gearing. When the locomotive is first put in service, add about 1 pound of grease weekly to each gearcase. Make frequent inspection through the filling openings to observe -if there is a good film of lubricant on the teeth. The required amount and frequency for adding grease thus can be determined. Avoid using more lubricant than necessary, a condition which probably exists when a considerable leakage of grease is noted, and at the same time the gear teeth show a good film of lubricant.

b. Double Reduction Gearing. When the locomotive is equipped with motors using double reduction gearing all gears and bearings except the bearing on the commutator end of the motor are lubricated from oil in the gearcase. For instructions on lubrication see LO 55-1268.

67. Center Plate

On swivel type trucks locomotives lubricate the center plates at least once a month and oftener if necessary. The oil used for the journal bearings will be suitable.

68. Lubricating Chart

a. Lubricate as directed in LO 55-1268.

b. It is important to observe (1) and (2) below when working out a lubrication schedule.

(1) Ball and roller bearings require the right kind and quantity of clean lubricant. Too much lubricant causes more harm than too little.

(2) Inspect all types of bearings frequently during an initial period to determine signs of wrong lubrication before serious damage occurs

Section III. HIGH POTENTIAL TESTS

69. Applying Tests

Diesel-electric locomotives operating under Interstate Commerce Commission regulations must comply with the requirements given in paragraph *253* of the Laws, Rules, and Instructions for Inspection and Testing of Locomotives other than Steam, governing periodic high potential tests on electric circuits and windings carrying current of potential over *150* volts. While these tests are not required of locomotives in industrial service it is recommended that they be applied after a general overhaul or after extensive repairs have been made to the electric apparatus.

70. Preparation of Locomotive for Tests

To prepare the locomotive for tests, proceed as follows

a. Clean the electrical circuits and windings to be tested by blowing out with dry compressed air.

b. Lift all of the generator brushes so that they will clear the commutator. Keep brush "pigtails" clear of the generator frame.

c. Refer to the locomotive connection diagram (fig. *34)*.

d. Disconnect the following

(1) Cable between field shunting control relay CR and ammeter shunt.
(2) Ground wire on field shunting control relay VI.

e. Block main contactor S1 closed, or insert a piece of metal between its contact fingers.

f. Set the reverser for either forward or reverse direction.

g. See that the engine starting contactor GS1, and generator field contactor, GF1 are open.

h. Do not disconnect generator ground cable

i. In order to avoid excessively high potential surges, always connect the high potential test wires to the circuits before energizing the test wires.

j. To avoid any possibility of personal injury, always stay outside and at least 10 feet away from the locomotive while tests are being applied.

71. Application of Test Voltage

a. The normal operating voltage of the traction motor and generator is considered as *225* volts. This is *75* percent of the approximate generator voltage (within *25* volts) at the maximum permissible speed of the locomotive.

b. The normal operating voltage of the battery and low voltage control circuits is considered as *37.5* volts. This is *2.34* volts per cell of battery, which is the approximate normal charging voltage. Therefore, according to ICC regulations, it will not be necessary to apply a high potential test to these circuits.

c. To apply high potential tests to each of the main circuits and motor windings, connect one high potential cable to any convenient point on the circuit to be tested and the other to the frame of the locomotive, and apply test voltage as specified by ICC requirements.

d. To test the generator armature, place one high potential lead on the generator commutator and the other on the locomotive frame and apply test voltage as specified by ICC requirements.

e. The generator commutating field windings, the ammeter and shunt, the starting field winding as well as the lead between CR and ammeter shunt always operate at less than 150 volts and are, therefore, not included in the high potential circuit.

f. Although the ICC requires the application of only *50* percent above normal voltage to windings, it is permissible on this equipment to apply a high potential test value of 75 percent above normal working voltage, except to the windings mentioned in the preceding paragraph.

g. After tests

(1) Remove all testing connections.

(2) Restore all original wiring and connections.

(3) Remove blocking from contactors.

Section IV. AXLE CHAIN

72. Lubrication

The chain is lubricated by means of two leads which conduct oil from the two sight feed lubricators in the cab. When the locomotive is in operation, the lubricators should be adjusted to give the minimum dependable rate of flow usually from 2 to 4 drops per minute.

73. Lubricator Leads

Inspect the lubricator leads frequently to make sure the oil is being delivered correctly. Oil should be delivered to the upper edges of sideplates of the lower run of chain. Oil applied on the center line of rollers or to the upper spans of chain is of little value in prolonging chain life and retarding wear. The lubricator leads should drip in the plane between roller link plates and pin link plates on both sides of the chain.

Note. Chain drives suffer more harm from faulty lubrication than from years of normal service.

74. New Chains

New chains should be oiled thoroughly, and provision made for adequate subsequent lubrication.

75. Recommended Lubricant

Light bodied oil of good quality, fluid at the prevailing temperature, is the best general purpose lubricant; SAE No. 40 for the summer-winter oil when temperatures are very low.

76. Low Grade Oils Harmful

Low grade oils should not be used. They will leave deposits in the chain joints, and prevent subsequent effective lubrication. Oils must be acid-free. Lubricants of animal or vegetable origin must not be used.

77. Heavy Lubricants

a. The most common mistake in chain lubrication, and a very natural one, is the use of heavy oils and greases, applied at ordinary temperatures, at which these lubricants are much too stiff to penetrate the small clearances of roller chains. Many excellent materials of this nature are suitable when lubrication must be intermittent, but only if cleaned chain is immersed in lubricants after they have been thinned by heating to 160° to 200° F. Higher temperatures will impair the lubricant and draw the hardness of the chain parts to some extent. After the chain and melted grease are at the same temperature, work joints to assist in filling the clearances, and remove chain. straighten out and allow to cool with the links pushed together, the chain pins being horizontal. Wipe off surplus lubricant with a rag dampened in kerosene o_ other petroleum cleaner.

b. For chains exposed to the weather, or for chains subjected to water drip, periodic immersion in heated steam cylinder oil, not dewaxed, is recommended. The frequency of application should be in proportion to the severity of service. After chains have been washer! down, a few minutes of idle running will work k. out much of the water.

c. Stiff lubricants, such as 600W graphite e sticks and cup greases, seal chain clearance=, and are of no value as ordinarily used at normal temperatures, although they unfortunately create the illusion of effectiveness because temporary quieting sometimes follows their application.

78. Cleaning

All chains should be thoroughly clew cleaned, old especially those exposed to grit and dirt. After thorough scrubbing in kerosene or other petroleum cleaner, with a brush, they should be rinsed in the cleaning fluid and drained. It is of great practical value to open the chain clearances, allowing ready access of lubricant that would otherwise be ineffective.

79. Idle Drives

Roller chains that are idle for appreciable lengths of time between seasons, especially those exposed to the weather or on portable equipment, should be removed, thoroughly cleaned after last usage, and well slushed in melted grease. The mechanical value of chain with rusted joints is very low, as subsequent chain and sprocket life will be short and the performance unsatisfactory.

80. Evidences of Good Lubrication

a. It is easy to determine whether chains have been lubricated effectively. If the lubricant is black at the joints, lubrication has been good. This will be confirmed if an examination of the pins of the connecting link, removed, discloses bright, polished surfaces with a high lustre. The pins of chains not well lubricated are discolored, light or dark brown, even on contact surfaces, and will be roughened, grooved, and galled. The chain joints will have a definite brownish hue. A greasy or oily exterior appearance may be entirely misleading, and is not acceptable evidence of good lubrication unless the chain pins are bright.

b. For all roller chain drives, consistent attention to lubrication will result in dependable, uninterrupted performance, exceedingly long drive life, and avoidance of expense and loss of time for making repairs or replacements.

Section V. POWERPLANT AND LOCOMOTIVE THROTTLE CONTROL TESTS AND ADJUSTMENTS

81. Description of Powerplant

The locomotive contains one power plant, consisting of a diesel engine direct-connected to a traction generator. The engine generator set furnishes power to drive the traction motor which is geared to the wheels.

82. Powerplant Operation

a. The maximum utilization of the locomotive powerplant is obtained over a wide range of operating conditions by properly coordinating the diesel engine power output and the traction generator excitation. This depends on the proper adjustment of the diesel engine fuel supply and the external traction generator field resistors.

b. When the locomotive is operated at full throttle, the power output of the powerplant is in accordance with the generator characteristic curve (fig. 24) and is limited by the full throttle setting of the fuel control lever on the diesel engine fuel pump. However, at partial throttle positions, the powerplant output and, therefore, the locomotive performance is determined by the locomotive throttle control system. This system provides varying degrees of generator excitation together with the proper fuel setting at any position of the throttle handle and thus establishes the necessary electrical circuits for application of power to the traction motor.

83. Powerplant Tests at Full Load

If the performance of the locomotive at full throttle indicates the necessity of adjusting the traction generator characteristic, proceed as outlined below

a. General Instructions and Precautions.

(1) Observe carefully all instructions pertaining to the operation of the locomotive powerplant (TM 55-1001) . Also become familiar with the following specific instructions concerning the adjustment of the generator characteristics.

(2) Make all test connections tight and well insulated. Ground or isolate any wires temporarily disconnected while making tests so they cannot become grounded or contact rotating equipment, control devices, or terminals.

(3) After completing tests, remove test meters and equipment and restore all connections to normal.

b. Generator Characteristics.

(1) Install test meters and equipment in accordance with figure 3 and provide a tachometer to read generator speed.

(2) Take a full load curve for the generator using a water box as load. Record generator voltage, load current, speed, and sufficient field voltage and current to indicate field resistance during test.

(3) Before proceeding, see that the fuel control lever on the diesel engine fuel pump is tight against the full fuel stop when the throttle handle is in the full throttle position.

(a) Resistance of field winding. The generator field must have a resistance of approximately 16.3 ohms. Equivalent resistance may be pro vided by the insertion of a variable test resistor in series with the field as shown in figure 3. If the generator is heated up by running to obtain the proper field resistance it should be held at approximately 315 amps and 1,800 r.p.m. (full throttle).

(b) Compressor load. Keep the compressor unloaded during generator tests.

(c) External field resistor setting. Set the external field resistor R7-R8 or R8-R11 (when supplied) at approximately 18 ohms. Hold 300 amps on the generator then, if necessary, adjust R7-R8 or R8-R11 to obtain 1,800 ± 20 r.p.m. at full throttle.

(d) Full load curve. After setting the external field resistor, take a full load curve beginning at 700 amperes and decreasing to 0 amps by approximately 100 ampere step. Compare this with curve (fig. 24). If the test voltage is low compared to the curve, increase the diesel engine fuel setting slightly by backing out the full fuel stop screw in the fuel control lever on the engine fuel pump. If necessary, reset the external field resistor, recheck the full load curve, readjust the .full fuel setting, and repeat until a satisfactory full load curve is obtained. Do not hold currents above 500 amps for more than 1 minute at a time. Take all readings with decreasing load.

84. Powerplant Tests at Partial Throttle

If the performance of the locomotive at partial throttle positions of the throttle handle indicates the necessity of adjusting the locomotive throttle control system, proceed as outlined below

a. General Instructions and Precautions.

(1) Carefully observe all instructions given in *b (3)* below.

(2) Do not attempt to make or check any adjustment at partial throttle positions based on no-load speed or voltage.

b. Partial Throttle Positions. Install test meters in accordance with figure 3 except generator field meters and test resistor are not necessary. Provide a tachometer to read generator speed.

(1) The distance in inches of each throttle position measured along the inside edge of the quadrant from the shutdown position of the throttle handle is as follows (see fig. 4)

Idling	3 ½
Motor line contactor closes (S1)	4 ± 1/8
First running position	4 ½
First generator field contactor opens (GF2).	51/4 ± ¼
Second generator field contactor opens (GF1).	6 3/8 ± 1

Check operation of throttle control switch (TC) with above table and adjust if nec essary.

(2) With the throttle handle clamped at a point 4 5/16 inches from the shutoff position, rotate the throttle operating cam assembly until the cam follower is at the neutral mark between the two halves of the cam in the position shown in figure 5.

(3) Start the diesel engine and clamp the throttle handle in the first running position, then adjust the length of rod from the throttle operating mechanism to the engine, by rotating the turnbuckle (see fig. 5), to get approximately 575 r.p.m. amps and 17 volts. If voltage is below 14, decrease resistance of external generator field resistor R6-R7. If speed drops after lowering resistance, increase fuel (lengthen rod) to maintain 575 r.p.m. If voltage is above 20, follow the reverse procedure.

(4) Stop the diesel engine and with the throttle handle in the full throttle position, adjust the full throttle cam of the operating mechanism by turning screw A (see fig. 5) to meet the cam roller when the fuel control lever on the engine fuel pump is tight against the full fuel stop.

(5) Recheck the values at the first running position as in (3) above; readjust fuel if necessary, and proceed as indicated in (3) and (4) above until the desired results are obtained. Final setting at first running position should be 250 amps, 17 -!- 3 volts and 575 -*L* 25 r.p.m.

Note. A convenient method of checking the first running position load with normal locomotive wiring connections, except with an ammeter in the traction generator armature circuit and a voltmeter across the traction generator armature, is to apply the locomotive brakes or otherwise block the drivers so the locomotive will not move, and hold the throttle handle at the first running position. This will load the traction generator on the traction motor. Do not hold this load for more than one-half minute at a time. If it is necessary to repeat this procedure several times, allow the locomotive to move a little between each trial to avoid localized heating of the traction motor armature.

(6) With the diesel engine running and with the throttle handle at the point where the first generator field contactor (GF2) opens adjust external generator field resistor R9-R10 to obtain 17 -!- 5 volts at 500 amps.

(7) Place the throttle handle in the idling position and adjust the idling cam of the operating mechanism by turning screw B (fig. 5) to obtain 490 to 500 r.p.m. with the compressor unloaded. With the compressor loaded and pumping against normal main reservoir pressure, the idle speed should not be less than 450 r.p.m.

Section VI. TRACTION GENERATOR

85. Description

The generator is rigidly connected to the engine, and the two are mounted as a unit in a three-point rubber suspension. A special coupling, longitudinally flexible but torsionally rigid, allows support of the engine end of the generator armature by the crankshaft of the engine, and allows the use of the generator armature as an engine flywheel instead of the conventional heavy flywheel.

86. Ventilation

The generator is cooled by air drawn into the machine by a fan. It is therefore, essential that a sufficient amount of cool clean air be provided, and that provision be made to prevent recirculation of the exhaust air. Adequate ventilation will not be obtained unless fan discharges against pressure no greater than intake air pressure.

87. Inspection

a. Inspect apparatus often enough to prevent failures in service. Inspection should include the following
(1) Cleaning.

(2) Commutator.

(3) Brushes.

(4) Brushholders.

(5) Lubrication.

(6) Field coils and connections.

b. Insure that lubrication is adequate, but not excessive, and that it is in accordance with instructions in LO 55-1268.

c. When the apparatus is undergoing general overhaul, inspect for defects not readily seen or detected in the assembled state.

88. Cleaning

a. It is essential that the apparatus be kept clean at all times. Blow out the machine with dry compressed air at least once a month. Approximately every 6 months, clean the insulation on the commutator cap and, when dry, paint with Glyptal No. 1201 varnish. Wipe the brushholder ring insulators clean, and remove any accumulations of oil and dirt.

b. After cleaning, examine the condition of the insulating varnish. If cracked, flaked, or blistered, treat the parts with varnish.

89. Disassembly (fig. 9)

a. Remove machine from vehicle and place on bench to facilitate handling. Lift brushes and wrap heavy paper around commutator surface to protect it. Remove grease fittings from commutator end. Remove bolts holding commutator end bearing housing to frame.

The armature, together with the commutator end bearing assembly, may then be drawn out of the fan end of the frame. To remove bearing, first unscrew countersunk flat head screws joining bearing housing to inner bearing cap and remove bearing housing. Unscrew nut on shaft holding inner races of bearing. The bearing may then be drawn off of the shaft together with the inner bearing cap by applying a puller, using the tapped holes in the inner bearing cap.

b. Do not strike any sharp blows when disassembling machine as this may damage the ball bearings.

c. After removing the armature, clean armature and inside of frame by blowing out with dry compressed air. Remove grease or oil with cloth dampened in carbon tetrachloride or a similar solvent.

90. Care and Maintenance

Field Coils.

(1) When field coils are to be removed, keep each pole, coil, and accompany shims together.

(2) To remove a field coil, disconnect the cables, remove the bolts which hold `he pole to the frame and remove pole and coil through the end of the frame. Exciting coils can readily be slipped off of the poles. Commutating coils are permanently assembled on the commutating pole pieces.

(3) Examine the condition of the insulating varnish surface on the field coils and when necessary give the following treatment.

(4) Paint or preferably heat coil in 120° C. oven. Dip while hot in Glyptal No. 1201 varnish and drain thoroughly. Bake for 8 hours at 120° C. (248° F.).

5) Before dipping, fill the bolt holes with glazier's putty to avoid filling with varnish. After the dip and bake, clean out the putty and wipe holes clean with a cloth dampened in G-E No. 1500 thinner or equivalent.

(6) It is important to have the frame sides of the pole pieces clean to insure their accurate seating against the frame. Reassemble the fibre pads between the coils and frame when installing field coils.

(7) Before reassembling, the terminals and contact surfaces of the poles should be clean. New main field coils or coils that have been hot dipped should be assembled in the frame while hot. Commutating poles with coils may be assembled cold. The hot coils will have more give to them to allow pulling down the poles tight against the frame. Place poles and accompanying shims in their original positions.

(8) Whenever pole piece bolts are removed, provide new lockwashers upon reassembling..

(9) After coils art- reassembled, take care that the cables are properly reconnected and the connections tight. Refer to figure 8 and carefully check coil polarity.

b. Brushholders.

(1) Inspect brushes periodically for wear and proper spring pressure; make sure that they are free in their holders and not stuck with dirt or other foreign substance. Brushholders, especially the insulating material, should be carefully cleaned at this time.

(2) The brushes supplied with electrical l equipment are of the proper grade for the service conditions. In making brush replacement it is essential that this same grade of brush or a G-E recommended replacement be used. Proper brush pressure should be maintained as specified in paragraph 95, as unequal brush pressure will cause unequal current distribution 1= the brushes.

(3) Item 1, figure 6 shows the correct method of measuring spring pressure. The reading is taken when the pressure between the brushholder lever and the brush is reduced sufficiently to free a piece of paper previously Inserted.

(4) When replacing brushes, they should be carefully fitted to the commutator, sandpapering first with a coarse grade and followed by fine grade of paper, making sure that they are sanded in the direction of rotation of the armature. Poor commutation will result from a poor brush fit.

(5) Item 2, figure 6, shows the method employed when it is necessary to fit an entire set of brushes. A strip of sandpaper, the width of the commutator and of sufficient length to wrap
one and one-quarter times around the circumference is cut, and one end is double as shown. The small end is inserted in a slot between segments, and the paper wrapped around so that by rotating the armature the proper direction, the paper will be held in place by the friction of the brushes.

(6) If only a few brushes are to be fitted, item 3 figure 6, shows a similar method.

(7) Maintain one-sixteenth inch clearance between the bottom of the brushholder and the commutator. The brush rigging is arranged so that the brushholder studs may be moved toward the commutator surface as the commutator wears or is turned so as to maintain the one-eighth inch clearance between the face of brushholders and the commutator. Keep brushholder rigidly bolted in place.

(8) Brushholders are designed to insure installation of brushes in a trailing position. There are two groups of brushholders-one group stamped B1 and the other group stamped B2. Each frame arm is similarly stamped B1 or B2 and brushholders must always be assembled so B1 brushholders are with B1 arm stamping; similarly for B2.

c. Commutator.

(1) The commutator should present a polished surface free from pitting. If it becomes pitted from arcing at the brushes, clean with fine sandpaper not carborundum or emery) or stone. When stoning the commutator, extreme care must be taken to keep the copper dust from the windings by using a cardboard shield or some other means; also cover the fan to keep it from sucking the dust into the machine. After stoning or sanding, blow the machine out carefully with dry compressed air.

(2) If the commutator is badly worn or burned, place the armature in a lathe and turn just enough to give a uniform surface. Check the shaft centers to make sure they run true with respect to the bearing seats. Before turning the commutator, place a suitable head covering over the end windings to prevent the chips working into the armature. While turning, the peripheral speed of the commutator surface should be about 300 feet per minute. Round off the end of the commutator segments to '/,; inch radius with a file.

(3) After the commutator has been turned, groove the side mica. Special saws are available for this purpose. Do not cut the slots too wide. Remove the sharp edges of the bars with a hand scraper or a knife. Do not bevel the edges of the segments. Remove all mica fins and inspect to see that no copper chips remain. Final polishing with a fine grade of sandpaper is recommended.

(4) Do not apply a lubricant to the commutator as it is detrimental to operation. If the commutator is not kept clean and free from grease and oil, carbon dust will collect in the grooves between the segments, and will cause a short circuit.

d. Armature.

(1) Inspect the armature for the condition of bands, coils, insulation, general assembly, and commutator.

(2) Armature bands should be tight and secure, and soldering on the bands should be intact. If solder has been thrown off, determine the cause, correct and replace bands.

(3) The coil insulation should be clean and free from blisters, flakes, or cracked insulating varnish surface. When condition of the insulating varnish on the armature is such that treatment is necessary, follow treatment prescribed under cleaning.

(4) Heat the armature to 100° C. (212° F.) and dip hot in Glpytal No. 1201 varnish. Specific gravity 1.15 to 1.18 at 30° C. Thoroughly drain excess accumulation of varnish and bake for 24 hours at an oven temperature of 120° to 125° C. (2480 to 2570 F.).

c. Balance. The armature is dynamically balanced at the factory. If anything is done to the armature which disturbs this balance, it should be rebalanced dynamically for best performance.

f. Lubrication. The bearing is grease lubricated. Refer to LO 55-1268. G-E ball bearing grease is recommended. Refer to LO 55-1268.

(1) Examine the grease fittings regularly to see that they are not damaged so as to allow dirt to enter the bearings. Before greasing, wipe the fittings clean so as not to force dirt into the bearing with the grease.

(2) The amount of lubrication depends largely on the service requirements. Grease should be added periodically but not excessively as it will work out of the housing and be thrown off to the detriment of the unit when it gets on brushes, commutators and windings, and clogs ventilating passages.

(3) As conditions dictate, take bearing assemblies apart and thoroughly clean with kerosene or similar solvent for the purpose of removing the accumulation of old and hardened grease from bearings, housings, and grease passages.

(4) In addition to a visual inspection, check the bearings for defects by rotating in the hand and feeling for grit or binding; also spin by hand and listen for defects.

(5) Immediately after bearings have been cleaned in the solvent, wash them in a light mineral oil of SAE-10 grade to prevent corrosion of the highly polished surfaces.

(6) For greasing schedule for traction generator armature bearings see LO 55-1268.

91. Reassembly (fig. 9)

a. Mount inner bearing cap over spacing collar on shaft. Press bearing into place on shaft or heat bearing to 100° C. and slip into place on shaft, holding it tight against spacing collar until cool. The grease seal side of the bearing should be on the inside. Place lockwasher on shaft and screw on bearing nut. Bend washer over on face of nut to lock nut. Repack bearing with grease. Mount bearing housing in place on shaft over bearing by tapping lightly around the edge of the housing. Bolt housing to inner bearing cap using the two, small, countersunk head, machine screws. Rotate bearing assembly on shaft to see that there is no binding.

b. Place heavy paper around commutator surface to protect it and slip armature into frame. The armature may be drawn into its final position with the bearing housing bolts.

92. Testing After Repairs

Make a high potential test at 1,000 volts ac of commercial frequency for 1 minute.

93. Lining Up Generator With Engine

a. The proper operation of the set requires that the generator shaft be in line with the engine shaft and that the air gaps be equally divided.

b. To insure this, make sure that the surfaces of the rabbet fits on the generator and engine are clean and that the bolts holding the generator to the engine are drawn up tight.

94. Inspection After Repairs

After repairs, make a careful check to see that no foreign matter remains in the machines and that no loose brushes or other obstructions are on the commutator. Check the connections with the diagram shown in figure 8. See that all bolts are drawn up tightly and locked.

95. Maintenance Data for Type GT-1503-X1 Traction Generator

a. Classification 6 pole, d-c self-excited, shunt wound, commutating pole machine.

b. Nominal rating for traction purposes-input-150 hp at 1,800 r.p.m.

c. Resistances at 25° C.

(1) Exciting field . . . . . .12.6 ohms
(2) Commutating field . . . . 0.0079 ohm
(3) Starting field . . . . . 0.00461 ohm
(4) Armature . . . . . 0.013 ohm

d. Brush data.

(1) Pressure.	80 to 96 oz. per finger
(2) Size	5/8 in. by 3 in. by 2 in. long
(3) Grade	GE-377

e. Commutator side mica.

(1) Grooving depth	3/64 in.
(2) Thickness	.0.030 in.

f. Bearing grease capacity (2/3 full) . . 3.0 oz.

g. Weight-approximately (not including coupling) . .940 lbs.

h. Prints and figures.

(1) Outline	fig. 7
(2) Connection diagram	fig. 8
(3) Bearing assembly	fig. 9
(4) Armature insulation	fig. 10
(5) Brushholder diagram	fig. 11

Section VII. TRACTION MOTOR

96. Inspection and Maintenance

a. The main traction motors, type GE733, are 6 pole, direct, current, commutating pole motors with double-reduction gearing. The motor is cooled by air drawn into the machine by a fan mounted on the armature shaft. The air enters the commutator end of the motor through perforated holes in the covers and is divided into two paths, one entering under the commutator and passing through longitudinal ducts in the armature core and out at the fan end; the other passes over the commutator surface and through the air gaps and between field coils, joining that from the armature path and is discharged by the fan through openings in the gear box casting, sheltered from wheel wash.

b. The single gear box casting contains bearing bores for both high and low speed reduction, machined integral in the one casting, thereby assuring correct gear centers at all times with a minimum chance of gear wear from misalinement. The gear box together with gear cover, when bolted together forms a tight fitting assembly to hold the oil which is used for both gear and bearing lubrication. The gear meshes are lubricated by dip and splash in the oil bath and both the anti-friction bearings and axle sleeve bearings are lubricated by splash from the gear train. It is essential that the proper oil level be maintained in the gear box at all times.

97. Frequency of Inspection

A systematic schedule for inspection and overhaul should be established. Routine inspection should be made every 3,000 miles as noted, and general overhaul 150,000 to 200,000 miles or every 2 or 3 years, whichever occurs first.

98. Routine Inspection

Every 3,000 miles, or once a month where less than 3,000 miles a month is operated

a. Remove commutator covers taking care that no oil, dust, or other foreign material falls into the motor. Clean commutator chamber by blowing out with clean, dry compressed air.

b. Inspect commutator. See that copper surface is free of copper beads and has a smooth and polished appearance.

c. Wipe off string band. This surface must be free of oil and dirt and have a smooth glossy finish.

d. See that brushholder mechanisms operate properly, shunts and terminals are tight, and porcelains are clean and in good condition. Examine surface condition and wear of brushes.

Replace short or broken brumes with new ones of the proper grade.

e. Examine armature, field coils, and connections for charred or broken insulation or other injuries..

f. Replace commutator covers.

g. Clean dirt from around filling plug on gearcase. Check oil level and, if necessary, add ,.ail to bring up to proper level.

h. For greasing motor bearings see LO 55.- 1268.

99. Overhauling

The following operations are recommended en it becomes necessary to remove the motors from the locomotive for general overhauling.

a. Clean dirt away from gear box and gear cover joints and around the oil filling plugs. Drain oil from gearcase and remove gear cover (approx. 1 gal. to 11/2 gal. of oil will remain inside the gear cover) .

b. Check radial wear and end play of the axle bearings.

c. Dismount the motor complete with gear 'pox from axle, and place horizontally on bench (upside down).

d. Remove motor from gear box.

e. Remove the armature and blow out dust and dirt with clean, dry compressed air. Re-condition per detailed instructions on armature and commutator.

f. Remove commutator end bearing housing to make sure grease leaks have not developed. Remove armature bearing and clean and inspect in accordance with detailed instructions for the care of bearings.

g. Blow out with dry compressed air and clean the interior of the motor, using carbon tetrachloride to remove any oil.

h. If the field coils and connections are tight and in good condition give them two coats of G-E No. 1201 Glyptal. If necessary to remove the coils, proceed as follows

(1) See that the brushholder mechanisms operate properly, shunts and terminals are tight, porcelains are clean and free from cracks, and carbon ways are not rough or worn.

(2) See that pole bolts are tight and properly locked.

(3) Examine gear teeth for wear. Measure and record end play of intermediate shaft in its bearing.

(4) Remove intermediate bearing housings, also pinion end armature bearing housing and examine rollers and races for year. Remove bearing parts for replacement if necessary. See instructions for the care of bearings.

(5) Reassemble armature bearing and commutator-end bearing housing on armature shaft.

(6) Reassemble the armature in the motor.

(7) Install new brushes if necessary.

(8) Before reassembling the bearing housing and bearing parts in the gearcase it is important that the interior of the gearcase be completely flushed out. with kerosene. Reassemble intermediate shaft bearing housings.

(9) Remount the motor on the gear box. Check to see that the 10 motor mounting bolts have a small "N" stamped on the head (this is a special high tensile strength bolt). Use new lockwashers under these bolts. Reassemble armature pinion-end bearing housing.

(10) Remount the motor and gear box assembly on the axle, replacing axle linings if necessary. See that all axle cap studs are tight in place and that al! nuts are drawn up tight and securely locked with cotter pins.

100. Removal of Motor Armature Pinions

Note. For pinion and bearing assemblies and details see figures 18 and 19.

The maximum safe speed of this locomotive (under own power, coasting or being towed) is 20 m. p. h., 4,000 r. p. m. on motor armature. When necessary to haul the locomotive in excess of 20 m. p. h. remove the motor armature pinions, thereby disengaging the motor armatures and preventing damage to commutators and windings due to overspeed. The instructions below outline the correct procedure in removing and replacing pinions. (See fig. 17.)

a. Remove the six capscrews (26) and lockwashers (25).

b. Using three lip-inch 13 jackscrews (with 21/z-in. thread) remove bearing housing (27) and pinion end bearing assembly (28). Screw jackscrews into the three tapped holes in the bearing housing and turn up not to exceed onefourth turn each, in orderly sequence, taking care not to "cock" the housing in its fit in the gear box. The internal clearance of this pinion end armature bearing is 0.002 in. and it is extremely important that this housing be removed parallel to the centerline of the armature with no cramping of the housing on the inner race whatsoever.

c. Remove the two capscrews (30) , lockwasher (29), and retaining plate (31), from end of armature shaft.

d. Using pinion puller 472956661 engaging the threaded extention of armature pinion (4), remove the pinion complete with inner bearing race (28). To prevent damaging the end of the armature shaft, be sure that center plug is in place on the end of the shaft. For use and details of pinion puller see figures 18 and 19.

e. For shipment from the factory, a dummy inner bearing race, (Cat. 6705444 for SKF NUS No. 60 Bearing; Cat. 6705538 for NH RY 560-A) made up of brass with a loose fit on the armature shaft, is furnished instead of replacing regular inner race for the purpose of holding up the armature so that its weight is not carried in the oil seal. It is recommended that these same parts, if available, be reused for tong haul.

f. Replace bearing housing and armature bearing assembly taking precautions to prevent cramping of housing. With inner race just started into engagement with rollers and working a bar under armature fan to balance armature weight, advance housing into position slowly using three capscrews (26) only without lockwashers. Draw up evenly on the three capscrews one-fourth turn maximum at a time, taking care that housing is always square with armature shaft. After housing has been drawn solidly into position, remove the three capscrews and replace all six capscrews with lockwashers.

101. Mounting of Pinions

After locomotive has been shipped with the pinions removed, the following procedure is recommended for replacement of pinions (see fig. 17)

a. Examine the pinions and inner bearing races to see that no damage has occurred to the polished surfaces. These should be wiped free of oil and examined carefully. Feel both outer and inner surfaces of bearing race and inner pinion "fit" surface. Check with the finger any suspected roughness. Do not attempt to assemble damaged pinions or bearing parts. Minor roughnesses may be removed using a fine grade of polishing stone.

b. Remove pinion-end bearing housing (27) from gear box using three 1/2-inch jackscrews screwed into the three tapped holes in the bearing housing. These jack screws should be turned up not to exceed one-fourth turn each, in orderly sequence, taking care not to "cock" the housing in its fit in the gear box.

c. Remove dummy inner bearing race, from shaft.

d. Check pinion taper fit on armature shaft for roughness or scratches.

e. Wipe shaft clean of oil, using a dry cloth.

f. Wipe pinion "cold" clean of oil using a dry cloth.

g. Check "cold" position of pinion on shaft. Push pinion firmly onto shaft taper as far as it will go. Do not strike with hammer. Record indicator reading or shim measurement, using Cat. 6705460 pinion advance gage registering on finished surface on pinion to end of armature shaft (fig. 14).

h. Place pinions in oven 150° C. (302° F.)leave pinions in oven approximately 2 hours. Check to get a temperature of 80° C. above shaft temperature (105° C. on pinion with 25° C. on shaft). Never heat pinions above 190° C.

i. Remove hot pinion and check inner fit to be sure it is clean and without hesitation proceed to assemble in place on shaft. With pinion nearly in engagement with taper fit (not in actual contact) snap forcibly into place with a quick push. It is important that the hot pinion be snapped into position instantaneously before pinion has cooled appreciably; or the pinion will immediately "freeze" to the shaft and cannot be adjusted further.

j. Check "hot" or shrunk-on position of pinion of shaft. Record indicator or shim measurement. Subtract

readings here taken from previous "cold" readings (see g above). The difference is the "advance" of pinion.

Note. Correct pinion advance is 0.030 inch to 0.035 inch. If less than 0.030 inch or more than 0.035 inch, promptly remove pinion and repeat.

If pinion advance is satisfactory, allow pinion and shaft to cool thoroughly and then proceed with assembly of inner race.

k. Place inner bearings races in 150° C. oven for approximately 1 hour to obtain a temperature of 100° C. above shaft temperature (125° C. on bearing race with 25° C. on shaft). Never heat hardened bearing parts above 135° C.

1. Remove bearing race from oven. Check that inner fit is clean and dry and without hesitation, push up solidly against register face on pinion.

m. Assemble retaining plate (31) , cap screws (30) , and new lockwashers (29) turning up corner of lockwasher after positively tightening capscrews.

n. Assemble bearing housing (27) (oil drain recess at bottom), taking precautions to prevent cramping of housing in gear box or marking of bearing inner race. See paragraph 100 b for details.

102. Lubrication---Oil

a. The two taper roller bearings on the intermediate shaft and the pinion end armature bearing are oil lubricated by splash from the gear train. Oil catches have been built into the gear box to pick up and deliver sufficient oil to these bearings to provide adequate lubrication daring normal running.

b. It is extremely important that the correct amount of lubricating oil of the proper viscosity be used to insure adequate lubrication of gearing and bearings at all times.

c. It is important that the oil level be maintained within one-fourth inch of the bottom of the top filling plug opening at all times. Check this point frequently enough to determine that there is adequate lubricant in the gear case at all times. Oil capacity is approximately 31/2 gallons.

d. After approximately 3 months of operation of the new locomotive, drain the oil from the gear case, remove the gear cover and completely clean of old oil and dirt, and refill gear case with new oil. Subsequently, remove the gear cover at least once a year to permit cleaning out, draining, and replacing of oil.

e. Under average summer temperature conditions use a well refined straight mineral oil without corrosive compounds or additives having a Saybolt universal viscosity at 210° F. of from 110 to 130 seconds and at 100° F. of from 1,500 to 2,000 seconds, (SAE-60 approx.). This lubricant should be suitable for lubricating gears, anti-friction bearings, and bronze sleeve bearing linings on the axle.

f . For operation in ambient temperatures of approximately 100° F. for extended periods of time, the lubricant should be one grade heavier but otherwise have similar properties to the above.

g. For extreme cold weather conditions where there will be considerable intermittent operation with ambient temperatures of 0° F. or below, use a straight mineral oil without corrosive compound or additives, having a Saybolt universal viscosity of 210° F. of from 64 to 85 seconds, (SAE-30 approx.). The pour point should be 0° F. or below. Oil must not channel at -20° F. and must be stable at temperature up to 180° F.

103. Lubrication-Grease

a. The commutator-end armature ball hearing is grease lubricated. G-E ball bearing grease is recommended for use in replenishing the grease in this bearing.

b. Examine the grease fittings regularly to see that they are not damaged so as to allow dirt to enter the bearings. Wipe the fittings clean before greasing so as not to force dirt into the bearings with the grease.

c. The amount of lubrication depends largely on the service requirements. Add grease periodically but not excessively as it will work out of the housing and be thrown off to the detriment of the unit when it gets on brushes, commutators, and windings, and will clog ventilating passages.

e. As conditions dictate, take bearing assemblies apart and clean thoroughly with carbon tetrachloride, kerosene, or similar cleaning fluid, to remove the accumulation of old and hardened grease from bearings, housings, and grease passages.

e. In addition to a visual inspection, check the bearings for defects by rotating in the hand and feeling for grit or binding, and also spin by hand and listen for defects.

f. Immediately after bearings have been cleaned in the solvent, wash them in a light mineral lubricating oil of SAE-10 grade to prevent corrosion of the highly polished surfaces.

g. When the bearing compartment is clean and dry repack about two-thirds full with fresh grease. When reassembling, pack some grease in the bearing itself. For greasing schedule refer to LO 55-1268.

104. Care of Roller Bearings

To insure successful operation of the roller bearings, observe the following precautions

a. Do not remove the original packings from spare bearings until immediately before they are to be used. Unwrap bearings in a clean, dry place, removing the packing grease by washing bearings thoroughly in carbon tetracholoride, kerosene, or some similar cleaning fluid. Immediately after washing, dry the bearing parts thoroughly **and further wash in a light mineral** lubricating oil of SAE-10 grade to prevent corrosion of the highly polished surfaces. Keep bearing parts covered at all times with clean rags or paper to prevent entrance of dirt or chips.

b. Bearings should be cleaned and inspected when the motor is taken apart for over-hauling. Clean bearings and housings promptly after removal from the gear box. Inspect the bearings for defective roller, rotating each roller. Inspect the cages for loose rivets. Inspect the races for signs of marking or pitting (both outer and inner race complete) do not attempt to reassemble damaged bearings. Replace with a new bearing any bearing which, in the opinion of the examiner, is questionable. The questionable bearing should be reconditioned or scrapped. Do not interchange inner and outer races of different makes of bearings.

c. For disassembly of motor and gear box see figures 16 and 17 respectively. Place motor and gear box assembly in a horizontal position on bench (upside down with respect to normal position in truck) with wood block under cylindrical motor frame.

(1) Remove the 10 capscrews and lockwashers -(1 and 2, fig. 17) thereby releasing the motor from the gear box. Using a heavy rope sling around motor and a hoist, remove motor complete with armature fan, pinion, and pinion end inner bearing race. To release frame from gear box, use three jack screws in the three tapped holes provided for this purpose.

(2) Remove cap screws (30), lockwashers (29), and retaining plate (31) from end of shaft.

(3) Using pinion puller 472956661, remove pinion (4) and bearing inner race at the same time from the shaft. To remove inner bearing race only, use puller 474837067.

(4) Remove cap screws (2) and lockwashers from the cummutator and bearing assembly (fig. 16).

(5) Remove brushes from brushholders and wrap cardboard around commutator to prevent damage.

(6) It is now possible to push armature and bearing assembly complete out of its fit in the frame, removing from the fan end.

(7) After removing the two flat head cap screws (22) , remove bearing cap (1), and gasket (17) ; bend up lockwashers (18) , and remove bearing nut (19) .

(8) Using a puller 474837068 engaging in the taped holes from which bolts (2) have been removed, remove bearing housing (4), flinger (15), and ball bearing (16) from the armature shaft.

(9) If necessary to remove armature fan (12) , use puller **4748370611,** engaging in the three tapped holes in the hub of the fan. Be sure that the center plug is used on end of shaft to prevent damage of center.

(10) Remove pinion-end armature bearing and bearing cap (28 and 27, fig. 17) using the three jack screws in hole provided for this purpose. Take care not to cramp the bearing housing in its fit in the gear box.

(11) Remove wire (5) , cap screw (6) and retaining ring (32) from housing (27) , and using puller 474837064 remove outer race and roller assembly from the bearing housing.

(12) Remove cap screw (11) , and using the three jack screws in holes provided + or the purpose, remove bearing housing (10) from gear end of intermediate shaft.

(13) Using puller 474837063 it is possible to remove the outer bearing cap (8) from the bearing housing (10).

(14) It is necessary to prepare a special adapter ring for use in the hydraulic press to remove intermediate shaft (20) from the assembled gear and pinion. This adapter should be a steel tube, 61/2 inches O.D., 51/2 inches I.D., approximately 10 inches long, adaptable for fitting ram of press. After removal of bearing housing (10) , assemble this tube in the space occupied by the bearing housing, registering against inner gear hub (7) with the gear box in a horizontal position under the press, intermediate shaft (20) vertical.

(15) Remove capscrews (11) and using three jack screws in the tapped holes provided for the purpose, remove bearing housing (17) from the pinion side of intermediate shaft. Keep shim pack together.

(16) Using puller 47483065, remove inner bearing cone (19) from pinion end of intermediate shaft.

(17) It is now possible to press the intermediate shaft (20) from both gear (7) and pinion (21) supported in the press on adapter tube described above. It will probably require a pressure in the order of 100 to 150 tons to press this shaft out of both gear and pinion cold. Both pinion (21) and gear (7) can then be removed through the open end of the gear case.

(18) Using puller 474837062, remove the outer bearing cup (18) from the bearing housing (17) .

(19) Using puller 474837066, remove inner bearing cone (19) from intermediate shaft (20).

105. Field Coils

Examine the condition of the insulating varnish surface on the field coils and give the following treatment when necessary

a. Under normal conditions, it should not be necessary to remove poles and coils from the frame for cleaning. To remove dirt accumulation use dry, clean, compressed air. Use carbontetrachloride to remove oil and grease. After cleaning thoroughly, heat the assembled frame to 100 ° C. (212 ° F.) in an oven and, while hot, dip in Glyptal No. 1201 varnish, commutator end up, allowing varnish to come up over C. E. connectors. Specific gravity of varnish should be 1.15-1.18 at 30° C. (86° F.). Wash off pinion-end rabbet fit and outside of frame with solvent. Bake frame in 120° C. (248° F.) oven for 16 to 20 hours. If dipping facilities are not available use a brush or spray, working from both ends to get varnish into space between field coils.

b. When necessary to replace the field coils in a frame for any reason, observe instructions in c through i below.

c. The field coils are permanently assembled on the poles and cannot be removed readily. Handle a coil and pole piece as an assembled unit.

d. Before reassembling, thoroughly clean the terminals and contact surfaces of coils, and frame side of pole pieces.

e. Before reassembling coils and poles, prepare the inner surface of the frame as follows

f. Remove torn paper insulation and replace with new paper properly, cemented to frame. Locate paper so that pole piece openings are lined up with pole piece bolt holes, and pole pieces may be drawn up firmly against the frame to give good magnetic contact. All varnish should be cleaned from pole seat surfaces.

g. Assemble poles and coils and connection straps in accordance with the connection dia gram. Securely bolt all connections and tape tightly.

h. Check coil polarity with connection diagram; pass current through the windings and check with magnetic compass needle.

i. Dip assembled frame in Glyptal No. 1201 varnish. Bake 16 to 20 hours at 120° C. (248° F.).

106. Brushholders

a. Inspect brushes periodically for wear, proper spring pressure and to make sure that they are free in their holders and are not stuck with dirt or other foreign substance. Carefully clean brushholders, especially the insulating material, at this time. Take care not to snap the spring as this might chip the brush.

b. The brushes supplied with electrical equipment are of the proper grade for the service conditions. In making brush replacement it is essential that this same grade of brush or a G-E recommended replacement be used. Proper brush pressure should be maintained as specified in paragraph 112, as unequal brush pressure will cause unequal current distribution in the brushes.

c. Item 1, figure 6 shows the correct method of measuring spring pressure. The reading is taken when the pressure between the brushholder lever and the brush is reduced sufficiently to free a piece of paper previously inserted.

d. When replacing brushes, they should be fitted carefully to the commutator, sandpapering first with a coarse grade and followed by fine grade of paper. Make sure brushes are sanded in the direction of rotation of the armature. Poor commutation will result from a poor brush fit.

e. Item 2, figure 6, shows the method employed when it is necessary to fit an entire set of brushes. A strip of sandpaper, the width of the commutator and of sufficient length to wrap one and one-quarter times around the circumference is cut and one end is double as shown. The small end is inserted in a slot between segments, and the paper wrapped around so that by rotating the armature the proper direction, the paper will be held in place by the friction of the brushes.

f. If only a few brushes are to be fitted, item 3, figure 6, shows a similar method.

g. Maintain one-sixteenth of an inch clearance between the bottom of brushholder and the commutator. The brush rigging is arranged so that the brushholders may be moved toward the commutator surface as the commutator wears or is turned so as to maintain the one-sixteenth of an inch clearance between the face of brushholders and the commutators. Keep brushholders rigidly bolted in place.

107. Commutator

a. The commutator should present a polished surface free from pitting. If it becomes pitted from arcing at the brushes, clean with fine sandpaper (not carborundum or emery) or stone. When stoning the commutator, take extreme care to keep the copper dust from the windings by using a cardboard shield or some other means; cover the fan to keep it from sucking the dust into the machine. After stoning or sanding, blow out the machine with dry compressed air.

b. If the commutator is badly worn or burned, place the armature in a lathe and turn just enough to give a uniform surface. For best results turn the armature in its own bearings to reduce eccentricity. If this is not possible, check the shaft centers to make sure they run true with respect to bearing seats. Before turning the commutator, place a suitable head covering over the end windings to prevent the chips working into the armature. While turning, the peripheral speed of the commutator surface should be about 300 feet per minute. Round off the ends of the commutator segments to at least one-sixteenth of an inch radius with a file.

c. After the commutator has been turned, the side mica should be grooved to the depth shown in paragraph 112. For thickness of commutator side mica refer to paragraph 112. Special saws are available for this purpose. Do not cut the slots too wide. Remove the sharp edges of the bars with a hand scraper or a knife. Do not bevel the edges of the segments. Remove all mica fins and inspect to see that no copper chips remain. Final polishing with a fine grade of sandpaper is recommended.

d. Do not apply a lubricant to the commutator as it is detrimental to operation. If the commutator is not kept clean and free of grease and oil, carbon dust will collect in the grooves between the segments, and will cause a short circuit.

108. Armature

a. The armature should be closely inspected for the condition of. bands, coils, insulation, generator assembly, and commutator.

b. Armature bands should be tight and secure. Soldering on the bands should be intact. If solder has thrown off, the cause should be determined, corrected, and bands replaced.

c. The coil insulation should be clean and free from blisters, flakes, or cracked insulating varnish surface. When condition of the insulating varnish on the armature is such that treatment is necessary, proceed as indicated in d below.

d. Heat the armature to 100 ° C. (212 ° F.) and dip hot in Glyptal No. 1201 varnish. Specific gravity 1.15 to 1.18 at 30° C. Thoroughly drain excess accumulation of varnish and bake for 16 to 20 hours at oven temperature of 120° to 1250 C. (2480 to 2570 F.).

109. Balance

The armature is dynamically balanced at the factory. If any thing is done to the armature which in any way will disturb this balance, it should be rebalanced dynamically for best performance.

110. Testing After Repairs

Give a high-potential test of 1,000 volts a-c of commercial frequency for 1 minute.

111. Inspection After Repairs

After repairs have been made, check carefully to see that no foreign matter remains in the machines, and that there are no loose brushes or other obstruction on the commutator. Check the connections with figure 8. See that all bolts are drawn tightly and locked.

112. Maintenance Data for Type GE-733-H1 Motor (Model 5GE733H1) Models 7GA. 33C2 and 7GA33C4 Gear Units

Classification 6 pole, d-c commutating pole machine.	
Resistances at 25 ° C	
Exciting field	0.00986 ohm
Commutating field	0.00905 ohm
Armature	0.01312 ohm
Brush data:	
Pressure	80 to 96 oz per finger
Size	3 in. by 5/8 in. by 2 in. long
Grade	GE-377
Minimum air gap:	
Exciting field	0.102 in.
Commutating field	0.138 in.
Clearance around fan:	
Minimum	3/64 in.
Maximum	3/32 in.
Commutator side mica:	
Grooving depth	3/84 in.
Thickness	0.045 in.
Bearing grease capacity (2/3 full)	
Commutator end	4 1/4 oz
Axle bearings:	
Diametrical clearance	
Minimum	0.015 in.
Maximum	0.045 in.
End play:	
Minimum	0.032 in.
Maximum	0.150 in.
Intermediate shaft end play:	
Minimum	0.008 in.
Maximum	0.010 in.
Weight	
Motor-complete with gear box gears and accessories	2,500 lb.
Motor only	1,075 lb.
Armature (with fan)	400 lb.
Prints and diagrams:	
Outline, motor and gear unit	fig. 13
Connection diagram	fig. 14
Armature insulation	fig. 15
Longitudinal (section motor)	fig. 16
Gear box assembly	fig. 17
Pinion and bearing puller assemblies.	fig. 18
Pinion and bearing puller details-	fig. 19
Pinion advance o gage	fig. 12

Section VIII. CONTROL EQUIPMENT

113. Type 17GC5 Reversing Switch

a. The Type 17GC5 reversing switch connects the traction motor to the generator in the proper relationship to give either forward or reverse motion of the locomotive, as desired. Besides the two running positions, the switch

also has a neutral or "off" position, midway between the two running positions in which the traction motor is entirely disconnected from the generator.

b. This switch consists of a set of movable and a set of stationary contacts. These are made of copper with silver contact surfaces. The switching fingers are clamped to an insulated square shaft in such a manner that they are self-alining and have an adequate wiping motion in either running position. The stationary contacts are mounted on blocks of an insulating compound. A star wheel and pawl definitely locate all three positions of the switch, which is operated by a lever at the operator's position.

c. A magnetic interlock prevents moving the switch from any position unless the engine throttle handle is in the idling position, thus eliminating any burning of the contacts.

d. An electrical interlock prevents the generator field contactor from closing when the reversing switch is in the "off" position.

e. Inspect the reversing switch periodically, possibly at the same time that traction motor is inspected. The actual frequency should be determined by local operating conditions.

The inspection should cover the following

(1) Check the main and interlock contacts for gap drop and spring pressure. Refer to (7) below.

(2) Replace any broken springs or shunts.

(3) Inspect switching fingers and contact blocks for burning; replace when necessary. Replace contact parts when the silver facing has worn through. The contacts are silver-faced and should require little attention. If it becomes necessary to clean the contacts preferably use a clean lintless cloth wet with carbon tetrachloride or use a fine file. Do not use sandpaper or emery cloth as these will leave harmful grains in the contact surface. If a file is used, care should be taken not to remove too much material.

(4) Check all connections for cleanliness, and tighten if loose.

(5) Paint the square shaft insulation with Glyptal No. 1201 insulating paint. If the insulation on the square shaft carrying the switching fingers is damaged or burned, apply new insulation. This can be obtained of proper size to fit over the old shaft. Take care to reassemble the switching fingers in the same position as originally assembled.

(6) Blow out all dust and grit with dry compressed air.

(7) Oil hinge pins with a thin lubricating oil such as G-E PC control lubricant No. 1. Shaft bearings are of a graphite alloy, and need no lubrication.

17GC5W4 DATA

Contact	*Drop or wipe in inches*	*Gap in inches*	*Pressure in Pounds*
Main	3/16 to *5/16*	*¾* to 1	15 to 22
Interlock	*3/32* to *4/32*	*10/32* to 13/32	¾ to 1

Lock coil catalog No. 2738669 Res. at 25C 117 ohms.

114. Types 17CM12 and 17CMl 5 Contactors

a. These contactors are light weight, single pole, magnetically operated with a bent-up frame construction and using a straight armature with rocker bearing. The contactor must be mounted with its supporting base in a vertical plane and with its contact tips up.

b. Where necessary, the contractors are provided with blowout coils and arc chutes to assist in rupturing the arc. The arc chute is easily moved, thus making the contact tips readily accessible.

c. The contactor should be manually operated during inspections to detect any mechanical difficulties. Care should be taken that all circuits are de-energized and the battery switch is open before manually closing or doing any work on the contactors.

d. Keep the copper contacts clean and if they become burned or pitted, dress up by light applications of a fine file. Extreme care should be taken to insure that full line contact is obtained across and between the two tip surfaces after filing. If the tips are too badly pitted, they should be renewed.

e. The type 17CM12L2 contactor has silverfaced contacts, and should require little attention. If necessary to clean the contacts preferably use a clean lintless cloth wet with carbon tetrachloride or use a fine file. Do not use sandpaper or emery cloth as these will leave harm ful grains in the contact surface. if a file is used. uses, take care not to remove too much material.

f. The type 17CM12J15 contactor has non-welding alloy contact tips. These are copper colored and are distinguished from the copper tips by having an "S" indented in the side. Maintenance should be the same as for copper tips.

g. Check the contact tip pressure periodic To do this, insert a thin piece of paper between the contacts, fully close armature either mechanically or by energizing the operating coil and attach a spring balance (with wire or string stirrup if necessary) to the head of the ;crew holding the movable contact tip. The glance should then be pulled, perpendicular to he line of contact, until the paper can be easily :loved. The pull at the instant the paper can be moved is the contact tip pressure. (fig. 20).

h. Check the tip gap and wipe of the contact periodically. The gap is the distance between tips when the contactor is fully open. The wipe, which is measured at the line of final tip contact, is a measure of the armature movement after tree tips touch. it It is the the that the movable tip would move from its position as it just touches the fixed tip to the position it would assume were the fixed tip not in place when the armature is fully closed against its stop.

i. The contactor is provided with an adjustable armature spring to obtain positive opening when the operating coil is de-energized. This spring was properly adjusted at the factory and should not require any further adjustment. In the event a contactor is dissembled or the adjustment is otherwise disturbed, connect the operating coil to a variable voltage source and check the pick up current against that specified in paragraph 115.

j. Renew the copper and alloy contact tips when worn half-way through. Replace the silver-faced contacts of the 17CM12L2 contactor when the silver facing has worn through. The braided copper shunt, which carries the current from the moving contact to the contactor terminal, should be inspected periodically and renewed before it becomes badly worn of broken.

15. Contact Data

Contactor	Symbol on locomotive wiring diagram	Ampere Cont. capacity	Tip gap or break	Wipe or wear allowance	Initial pressure	Final pressure	Catalog No..
17CM12BE2	S1	350	**13/32** to **16/32** in.	**11/,32** to **13/32** in.	21/2 to 4 lbs.	10 to 13 lbs.	2738575
17CM12L2	Ml	275	**13/12** to **16.32** in.	**11/32** to **13/32** in.	2 ½ to 4 lbs.	10 to 13 lbs.	2738575
17CM12J15	GS1	275	13/32 to **16/32** in.	**11/32** to **13/32** in.	7 to 10 lbs.	18 to 22 lbs.	2738770
7CM15CC29	GF1, GF2	18	1/2 to **21/32** in.	7/32 to **9/32** in.	11/2 to 2 lbs.	3 to 4 lbs.	2738750

16. Operating Coil Data

Ohms resistance at 25°C.	*Approximate pickup amperes*	*Catalog No. blowout coil*
38.6	0.45	
38.6	0.45	
6.4	2.0	
7 3.	.25	4739111

17. Interlocks on 17CM Contactors

a. The engine starting contactor is provided with an electrical interlock

b. This interlock consists essentially of a contact bar attached to the contactor armature through insulation and contact fingers which are attached to the contactor frame through insulation. Contact pressure, contact wipe, and tip gap or break should be checked periodically. It should seldom be necessary to check the exact pressure except when the contact is suspected of being faulty. Wipe, pressure, and break are given in the interlock data. (d, below).

c. Both the stationary and moving contacts

attention. If it becomes necessary to clean the contacts preferably use a clean lintless cloth wet with carbon tetrachloride or use a fine file. Do not use sandpaper or emery cloth as these will leave harmful grains in the contact surface. If a file is used, take care not to remove too much material. Replace contacts when the silver facing has worn through.

d. Interlock data.

Contactors used on		Symbol	Wipe	Tip gap or break	Pressure
Type	Type				
17AF14H1	17CM12J15	GS1	3/32 to 5/32 in.	6/32 to 9/32 in.	8 oz
17AF14H1	17CM12L2	M1	3/32 to 5/32 in.	6/32 to 9/32 in.	8 oz

118. DB-1687-C4 Relay (VI)

a. This relay is of the magnetic type, having a hinged armature. The armature carries the contact making finger. The finger is spring mounted and all contacts have silver facing.

b. The "pickup" voltage can be adjusted (over a limited range) by changing the deenergized position of the armature, thus varying the air gap. This adjustment is obtained by moving the lower stationary contact stud up or down. Increasing the air gap increases the pickup voltage.

c. The "dropout" voltage can also be adjusted by changing the tension of the spring which is attached to the armature, decreasing the tension to- lower the dropout voltage and increasing it to raise the dropout voltage. Always recheck the pickup setting after any change is made in the dropout setting as it may also be affected.

d. The contacts being silver-faced should seldom require attention. If it becomes necessary to clean the contacts preferably use a clean lintless cloth wet with carbon tetrachloride or use a fine file. Do not use sandpaper or emery cloth as these will leave harmful grains in the contact surface. If a file is used, take care not to remove too much material. Replace contacts when the silver facing has worn through.

e. Check the contact tip gaps and wipes periodically. The wipe of the contact can be adjusted by screwing the stationary contact stud in or out. The tension of the armature balancing spring must always be sufficient to obtain full wiping action of the contact fingers making in the de-energized position of the relay. By the term "wipe" is meant the distance the moving tip would travel after it touches the stationary contact if the stationary contact were not there. With proper operating adjustment the tip gaps should always be equal to or greater than the minimum value specified.

(1) Wipe-i/1 6 inch minimum

(2) Break-1/ 6 inch minimum

119. 17LS8A2 Control Relay (CR)

a. The 17LS8A2 control relay is used to prevent the operation of the locomotive in the field shunting connection when the locomotive exceeds a speed specified on the locomotive connection diagram, figure 34.

b. The relay is of the series type and operates on the current passing through the armature. It is calibrated to drop out at the current value specified on the diagram, (fig. 34) which corresponds to the current flowing through the traction motor circuits when the locomotive has reached tile speed specified in figure 34, with the field shunting contactors closed. Higher locomotive speeds will give less current so this effect is utilized to cause the traction motor to drop back to its full field connection and thus prevent shunt field operation at high speeds.

c. The relay is made up of a heavy series coil designed to carry the traction motor current. This is mounted upon magnetic structure which operates an armature carrying a single normally open contact, the whole being mounted upon a wooden base.

d. Inspect the relay to see that the armature is free to operate. Occasionally check the calibration to see that the relay drops out at the speed of the locomotive specified in figure 34. This check must be made with the throttle handle in the "full" throttle position.

e. The contacts are silver-faced and should require little attention. If it becomes necessary to clean the contacts, preferably use a clean lintless cloth wet with carbon tetrachloride or use a fine file. Do not use sandpaper or emery cloth as these will leave harmful grains in the contact surface. If a file is used, take care not to remove too much material. Replace contacts when the silver facing has worn through.

120. Resistors

a. Various types of resistors are used for different circuits. For connections refer to figures 21, 22, and 34.

b. Type 17EW resistors are furnished for the traction motor field shunting circuits. Inspect these resistors periodically to insure that the tie rods holding units in place are tight and that all connections are tight. The insulation between units should be kept clean at all times by blowing out with dry compressed air, taking care that the pressure is not too high.

c. Adjustable type resistors are furnished on type 17FR panels. These resistor panels, when provided, are for the generator field circuits. Inspect these resistors periodically to insure that the tie rods and all clips and terminals are tight. Inspect the resistor windings to see that they are not broken or nicked, or have any short circuited turns. Replace cracked or broken porcelain tubes.

d. Vitreous enameled resistor tubes are also provided for generator field, light, and heater circuits, these being mounted on type 17FR panels. Examine resistors periodically to insure that the terminals are tight and the tubes have not been broken or damaged.

121. Type 17HE8C1 Control Switch (TC)

This is a cam-operated switch having three normally open contacts, operated from the throttle operating shaft through a suitable linkage so that the position of the switch corresponds to the position of the throttle handle. .In this manner, the switch is used as a controller to control the operation of the tractions motor contactors and the generator teaser field contactors.

22. Inspection and Maintenance

a. Inspect all terminals and contacts to make sure that they are tight.

b. Turn the cam shaft through its operating :'tinge to make sure that it turns freely and that Y good contact is made between the movable fingers and the stationary contacts.

c. Both stationary and movable contacts have sliver contact surfaces and should require little attention 1f it becomes necessary to clean the preferably use a clean lintless cloth wet. with carbon tetrachloride or use a fine file. Do not use sandpaper or emery cloth as these will leave harmful grains in the contact surface. If a file is used, take care not to remove too much material. Replace contacts when the silver facing has worn through.

123. Type DO Instruments

a. These instruments operate on the D'Arsonval principle, using a permanent magnet for the field and a coil on the moving element for the armature.

b. Inspect these instruments periodically to insure that the terminals are tight, that the pointers are on zero, and that the pointers do not stick.

c. The pointer may be set on zero by turning the small screw which is located on the front ox the cover. This screw, by means of a small cam changes the position of the metal piece to which the coil spring is attached, thus changing the tension on the spring and moving the zero position of the pointer accordingly.

d. The pointer may be tested for sticking by electrically obtaining maximum deflection and then noting results when the circuit is broker.. If the pointer does not readily return to zero. remove the instrument for cleaning and calibration.

e. Make no attempt to adjust or remove the instrument from the circuit unless it is certain that the current is off, as the terminals and the elements of the instrument are alive.

f. Where external shunts are used with ammeters, the ammeter must be calibrated with a shunt of the same current and millivolt rating as the shunt with which it is to be used. The shunt leads must be of approximately the same resistance as that of the leads with which the ammeter is to be used.

g. Install shunts so that metallic dirt or dust cannot get on the resistance strip and short circuit the shunt. Keep terminal screws tight at all times. Do not allow leads to become wet and thus short circuited. Although artificial ventilation is not required, the temperature rise may be from 40° C. to 50° C. (72° F. to 90° F.) above the ambient. There should be enough natural ventilation to take care of this rise.

h. Where voltmeters are provided with external resistors, care must be taken that the voltmeter is calibrated and used with its external resistor.

i. Whenever cleaning or calibration becomes necessary, the voltmeters should be returned to the manufacturer.

Section IX. AUXILIARY GENERATOR

124. Characteristics

a. The LEECE-NEVILLE auxiliary generator and control unit is used for charging a 16 cell lead acid type battery and providing current for lighting and control equipment. The generator, rated at 700 watts or 20 to 21 amperes, 32 to 40 volts at 900 r. p. m., is a direct current, four-brush shunt-wound engine-driven unit. Looking at the commutator end, it is designed for clockwise rotation for the type 2023-G generator, and counterclockwise for the type 2022-G. For internal connection diagrams see figure 29. For operation of generators in parallel see figure 34.

b. The generator is connected to a TYPE 2022 R16 LEECE-NEVILLE, voltage control unit. The apparatus and internal connections in the control unit are shown in figures 3 and 4.

125. Inspection

Apparatus should be inspected often enough to prevent failure in service. Inspection should include

a. Cleaning. The apparatus must be kept clean at all times. At least once a month, blow dirt or brush dust out of the commutator-end housing (10) , and brush rigging (11, fig. 28) , with dry compressed air.

b. Commutator. Inspect for roughness or eccentricity. If using No. 00 sandpaper does not correct this, or if the mica projects, or is about to project above the copper segment surface, the commutator must be resurfaced as described in paragraph 96.

c. Brushes and Brushholders. Check periodically for wear, proper spring pressure and to see that brushes are free in the brushholders. When brushes are worn down to 11/16 inch length, it is advisable to use the second notch of the levers. Replace brushes when they are worn down to 9/16 inch length. Refer to paragraph 95, for spring pressures. Also check for loose, shorted, or grounded connections.

d. Lubrication. Lubricate generator bearings (3 and 34, fig. 28) as directed in LO 55-1268. Do not lubricate excessively as oil mad- enter the generator and cause failures.

126. Commutator

If the commutator is rough, burned or eccentric it must be resurfaced in a lathe. Turn off only enough copper to leave a uniformly true surface. The minimum diameter to which the commutator can be turned is 219/,32 inch. The new diameter is 231 inch. Do not turn off any copper from the commutator risers (42, fig. 28). After the commutator is turned, carefully undercut the mica insulation between the copper segments to a depth of 0.030 inch. Remove the sharp edges of the bars with a hand scraper or knife. Smooth and polish the commutator surface with fine sandpaper. Test armature for short circuits.

a. Disassembly (fig. 28) .

(1) Make adjacent center punch marks on housings (10) and (22) and field ring (20) so that these marks can be lined up in assembly to locate the parts in their original position.

(2) Remove brush opening band (40).

(3) Lift up levers (13) to relieve spring pressure, taking care not to snap them down which will damage the brushes.

(4) Now brushes (12) may be removed from brushholders (14) . Do not pull "pigtails" out of brushes.

(5) Remove screws (1), bearing retainer (2), bearing retainer nut (5), and nut lockwasher (6). Do not remove flat head screws (46).

(6) Remove driven-end housing screws (33).

(7) With a brass rod held against exposed commutator-end of armature shaft at (4), drive the shaft out of roller bearing (3).

(8) The armature (38) with driven-end housing assembly (22) will now be free.

(9) Place armature (38) in a bench vise and remove screws (31), bearing retainer (26), bearing retainer nut (29) , nut lockwasher (28) , and spacing collar (30) . Do not remove flat head screws (37).

(10) Press armature (38) out of driven end ball bearing (34).

(11) Disconnect all internal connections from brush rigging (11) .

(12) Remove screws (39) and take away commutator-end housing (10) .

(13) Removal of two square head screws through two arc-shaped slots in outer face of commutator-end housing (10) will release brush rigging (11).

(14) Removal of flat head screws (37) and (16) will release the inner bearing retainers at the driven-end and commutator-end.

(15) Do not disassemble pole pieces (17) and field coils (19) from field ring (20) unless the field coils have to be replaced.

b. *Inspection and Reassembly.*

(1) Clean all parts before reassembly.

(2) Carefully inspect to determine if any repairs or replacements are necessary.

(3) Test armature and field coils for round with test lamp using alternating current.

(4) Field coils are connected in series and have a resistance of 21.5 ohms ± 0.5 aim. At 32 volts the current will be from 1.45 to 1.5 amperes. Replace armature or field coils if necessary.

(5) Discard brushes (12) when worn down to 9/16 inch length for full diameter commutator or 5/8 inch length or minimum commutator diameter. New brushes are 13/16 inch long.

(6) The brush spring pressure range is 3 to 3 1/4 pounds up to the fourth notch of the brush lever.

(7) For reassembly, reverse the procedure outlined in disassembly, but note following instructions.

(8) Make certain that the pilot diameters, matching diameters, and facings on housings and field rings are not nicked or burred to insure proper alinement.

(9) Use new felt washers (45) and saturate them in No. 6 Keystone condensed oil medium or equal.

(10) Use new tabbed lockwashers under all square and hex head screws and new spring lockwashers under all tabbed lockwashers except bearing lockwashers.

(11) Pack bearings (3) and (34) with New York and New Jersey Lubricant No. S-58 non-fluid oil (grease) or equal.

(12) Attach inner bearing retainer (8) to commutator-end housing (10) with flat head screws (46) . Attach brush rigging (11) with two square head screws and their tabbed lockwashers. Do not install brushes at this time.

(13) Start straight and press in roller bearing (3) then hold bearing in place with a temporary steel outer retainer made 1/8 inch thick with its outside diameter 27/8 inches. A hole 11/8 inch in diameter is to be punched in the center and four holes drilled with No. 15 drill (.180) spaced equidistantly from each other on the circumference of a circle whose radius is **17/32** inch..

(14) Fasten this commutator-end housing assembly on the field ring assembly (20) with screws (39) and bolt spring and tabbed lockwashers.

(15) Attach inner bearing retainers (23) and (24) and oil saturated felt washer (36) to driven-end housing (22) with flat head screws (37).

(16) Start straight and press ball bearing (34) in place. Put fan key (35) in place and press fan (21) to stop shoulder on armature shaft. Press armature (38) into bearing in driven end assembly using a tubular drift against the inner race to prevent damaging the bearing.

(17) Slide the armature and driven-end housing assembly into the field ring and commutator-end housing assembly. Drive the armature shaft in the roller bearing with a lead hammer hitting alternately on the shaft and around the edge of the housing. Make certain the pilot diameter of driven end housing (22) enters the field ring (20). Fasten housing (22) to field ring (20) with screws (33) and both spring and tabbed lockwasher.

(18) Remove temporary steel outer retainer and proceed with the rest of the assembly.

Section X. CONTROL UNIT

127. Voltage Control Unit

The voltage control unit (fig. 30), consists of

a. A cutout relay which connects the generator to the battery when the proper speed and voltage for battery charging is obtained. Below this voltage the relay contacts are open, disconnecting the generator from the battery.

b. The voltage regulator automatically limits the generator voltage in order to agree with the battery throughout the charging cycle. It will permit a comparatively high charging current when the battery is low, but prevents too high a current from damaging the battery when in a charged condition.

c. The load limitor controls the ampere output of the generator. When properly adjusted it will allow maximum safe output of the generator. Above this output the armature of the limitor will vibrate and when its contacts open, a controlling resistance is introduced to give proper ampere output. It is important that control of ampere output up to the generator capacity should be attempted only by adjustment of the load limitor. Do not try to vary ampere output by resetting cutout relay, voltage regulators or trip relay.

d. The trip relay will prevent a reverse current from damaging the unit if the cutout relay should accidentally become closed when the generator is below charging speed. The trip relay will form a shunted circuit around the cutout relay series winding and cause the latter to open.

e. Resistance units R6 and R7 are for control in the voltage regulator circuit, and rectifier R8 prevents destructive arcing of the voltage regulator.

128. Adjustment and Tests

a. It is advisable to check adjustments frequently at first, then regular periods of inspection may be established as conditions dictate.

b. Due to operating conditions on the locomotive it is not always practical to make adjustments to the regulator while installed on the locomotive. Consequently in some instances, it will be necessary to remove the charging generator and control equipment to a test stand or provide a small variable speed engine or motor drive the generator.

c. The units should be connected according to the diagram shown in figure 32, when the equipment is adjusted in the locomotive. Any adjustments made on a test bench connection should be made as shown in figure 30.

d. When equipment is adjusted on the locomotive care must be taken that the engine idling speed is adjusted to 550 r. p. m. for the Cummins HBI engine, and 500 r. p. m. for the HBIS engine. Due to the fact the engines are governed at 1,800 r. p. m. and different generator to engine speed ratios are used on the standard and supercharged engines, care must be taken to obtain the generator speed shown in the adjustment specifications.

129. Cutout Relay

a. Gap adjustments

Gap	*Inches*	*Adjustments*
C7	0.070 to 0.075	Bend armature stop C5.
C8	0.035 to 0.038	Bend thin carrier C6.
C3	Approximately 0.005	Loosen screws C1 and move bracket.
C9	0.022 to 0.025	Adjust C3 to obtain.

b. Disconnect battery wire from terminal B-.

c. Contacts C7 and C8 should close when voltage measured across terminals G- and G+ is from 29 to 30. Turn adjusting nut C2 clockwise to increase and counterclockwise to decrease voltage to obtain adjustment.

d. Connect the battery wire from terminal B- and from a generator speed where the contacts C7 and C8 are closed, decrease generator speed to complete stop. The contacts should open when the current in the line is from 0 to 4 amperes. If necessary readjust nut C2 to obtain this and recheck contact closing voltage.

130. Voltage Regulator a. Gap adjustments

Gap	Inches	Adjustments
R5	0.045 to 0.051	Hold contact open and adjust with screw R4
R10	0.060 to 0.065	Thickness of R9. File if necessary.

b. Disconnect battery from terminal B-.

c. With generator running in proper direction at a speed of 2,500 r. p. m., the voltage across B- and B+ should be from 38.0 to 38.5 volts. If it is not, turn adjusting nut R1 until this is obtained. Make a final check by increasing generator speed from 0 to 2,500 r. p. m.

131. Load Limitor

a. Gap adjustments

Gap	*Inches*	*Adjustments*
L1	0.025 to 0.030	Hold contact open and adjust with screw L2.
L7	0.023 to 0.028	Thickness of L8, file if necessary.
L4-	Approximately move 0.005	Loosen screw L5 and bracket.

b. With battery connected, run the generator at 2,000 r. p. m. Using a lamp or resistance load of 20 amperes on the generator, the ammeter in the line from the generator to B-should read between 20 and 21 amperes. If lower than 20 amperes or higher than 21 amperes, bend bracket end L6 to increase or decrease spring pressure.

c. Recheck and readjust voltage regulator if adjustment has changed.

132. Trip Relay

a. Gap adjustments

Gap	**Inches**	**Adjustments**
T1	*9/64*	Bend armature stop T5

Core gap between armature T2 and coil core should be from 0.032 to 0.038 inches, when contacts T1 are closed. This is adjusted by loosening spring bracket screws and moving the bracket up or down.

b. With battery connected and generator running, momentarily hold contacts R5 and L1 closed. The load from battery to B- should be 35 amperes when trip relay contacts T1 close. If below 35 amperes, increase spring tension by turning nut T4 slightly clockwise, and if the load is higher than 35 amperes decrease spring tension by turning counterclockwise. After each adjustment, momentarily hold contacts R5 and L1 closed and check adjustment.

Section XI. INSTRUCTIONS FOR TYPE LX-G EXIDE BATTERIES IN DIESEL-ELECTRIC LOCOMOTIVES

133. Charging-Regulator Settings

a. Keep the voltage regulator in adjustment in order to maintain battery fully charged as shown by a hydrometer reading.

b. The voltage regulator setting to use depends somewhat upon the number of hours per day that the locomotive is in service. However, for 8 to 12 hours' daily service, set regulator at 38 volts open circuit for the 16-cell battery as a trial start.

c. The regulator may have to be changed for local conditions. Make any adjustments in small steps, one-half volt at a time. Use an accurate voltmeter. Follow the instructions furnished with the locomotive in making adjustments and 42 adjust with the regulator on open circuit and with its coil hot.

d. Decrease the voltage setting if the battery specific gravity is found at the full charge value and with the electrolyte temperature more than 15° F. above the outside air, or if the amount of water required is more than that specified in paragraph 135.

e. Increase the voltage setting if the battery specific gravity drops off from day to day.

134. Readings and Records

a. Daily.

(1) Take hydrometer reading, electrolyte temperature, and level of pilot cell at end of working period.

Every month use a different cell as a pilot.

(2) Daily readings are desirable when the equipment is new, or after repairs, or after changes are made in the voltage regulator setting. When five daily readings show no adjustment needed, the pilot cell reading may be taken weekly.

b. Monthly.

(1) Record hydrometer reading of every cell. Compare these with previous readings to detect any irregular readings.

(2) Check and record setting of voltage regulator.

(3) Record amount of water added from time to time.

(4) Keep the records in a log book for reference by the supervisor.

135. Adding Water

a. Add approved or distilled water to each cell. The high point is $^{1}/_{16}$ inch below bottom of filling tube (or *9/16* in. above top of separators). Add before level lowers to top of separators.

b. Sufficient watering space has been provided so that with normal conditions water is required only once a month. However, check level each week.

c. All cells should take the same amount of water. If one takes more than the others, examine it for leakage.

d. If more than the maximum amount of water is required, unnecessary overcharging is indicated and the voltage regulator setting should be checked. If the minimum is not used for a battery in average service, undercharging is expected.

	Water additions per month	
	Minimum	Maximum
16 cells-LX-19G	1 ½ qts.	2 ½ qts.
16 cells-Lx-21G	1 ¾ qts	3 qts.

136. Keeping Battery Clean

a. Keep vent plugs tight and in place at all times. Once a month blow dirt off cell covers, trays and out of compartment with moderate air pressure.

b. An accumulation of acid-soaked dirt on top of the cells and in the compartment causes grounds, shorts, and corrosion. If cell covers are damp with electrolyte, wash them with bicarbonate of soda solution (1 lb. soda to 1 gal. of water), rinse off with water and blow moisture off cell covers and out of compartment with moderate air pressure.

c. Keep connections clean and tight.

137. Specific Gravity-Hydrometer Readings

a. The specific gravity or hydrometer reading of the battery is indication of the state of charge. The specific gravity reaches a maximum when the battery is fully charged, but this maximum value varies somewhat with the temperature and height of the electrolyte.

b. With the electrolyte level one-sixteenth of an inch below bottom of filling tube, the full charge specific gravity at different temperatures is as follows

(1) 77° F. - 1.270 - 1.285
(2) 107° F. - 1.260 - 1.275
(3) 47° F. - 1.280 - 1.295
(4) 17° F. - 1.290 - 1.305

c. With the electrolyte level at a lower point, the specific gravity for each temperature would be a few points higher.

d. A specific gravity about 75 points below values given above (1.200 at 77° F.) would in indicate a battery approximately one-half charged.

138. Important Points

a. Do not work on battery or in battery compartment without first opening the main battery switch.

b. Keep all flames away from the battery.

c. Do not lay any tools on top of cells.

d. Low electrolyte temperatures temporarily reduce the battery capacity. Restoration of normal temperatures restores the usual capacity.

e. Continued and frequent temperatures above 115° F. shorten the life of the battery. Provide full ventilation in warm weather.

f. With proper operation, the battery temperature should not be more than 15° F. higher than the temperature outside air.

139. Location

The compressor should be installed in a clean, well lighted place, with plenty of space all around it, so that it is accessible from all sides. Do not place compressor too near other machinery or too close to the wall. Compressor should be set on a firm foundation and securely bolted down.

140. Piping

a. Air discharge pipe must be full size of discharge opening on air cylinder. The discharge pipe should be as short and direct as possible, eliminating short bends and fittings and avoiding pockets. If for any reason it is necessary to install a gate or glove valve between compressor and receiver, it is imperative that a pop safety valve be placed in the line between compressor and the valve.

b. *As* the air cools in being carried through the distributing lines to the point at which it is to be used, it deposits moisture mixed with a small amount of oil. This moisture is objectionable in pneumatic tools, sand blasting, paint spray work and similar operations. Much of the trouble with water in the air lines can be overcome if small receivers are put in the lines at frequent intervals to act as collecting tanks, otherwise, suitable moisture traps should be used.

141. Air Receiver

When possible locate the air receiver outside the building where it has an opportunity to radiate most of the heat. Drain cock should be located at the lowest point in the receiver for drawing off the accumulated oil and water at least once a day. Where there is danger of freezing, safety valve should be located on the inside wall, preferably with the compressor control equipment. The safety valve should be tested frequently by hand, to be sure that it does not stick.

142. "V" Belt Drive

"V" belt drive consists of a number of rubber fabric composition ropes or belts operating in grooved pulleys. Adjustable motor base is provided to take up stretch of belts. Belts should be run only fairly tight. Slight inequalities of length in the various strands need cause no concern as belts will equalize on tight side under load. No belt dressing of any sort is required. Never attempt to run new belts with part of the old belts. The new belts will carry all the load and probably fail before they have stretched to the length of the old belts. *Always install a complete set of new belts*.

143. Before Starting

a. *Fill* the crankcase with lubricating oil to the high mark on the bayonet type oil gage. Go over all bolts and nuts to see that they are tight. When starting for the first time run the compressor with the receiver outlet valves wide open for about 10 minutes, so that oil will be distributed over all wearing surfaces. When sure that the unit is operating satisfactorily, partly close the receiver valves and gradually bring up the pressure to the normal working pressure.

b. The compressor must be run in the direction indicated on drawing, so that fan will blow air over compressor. The motor leads must be connected to give the required direction of rotation.

144. Lubrication

Oil level in the crankcase must be maintained between high and low level marks on the gage. Use a good grade of air compressor oil as recommended on the plate attached to the compressor. Add oil as required to maintain the correct level and change oil after each 200 hours of operation. The quantity of oil required for the compressor is 3 pints. In cold weather see that oil is of proper viscosity to flow freely at temperatures encountered.

145. Bearing Adjustment

a. Main bearings are Timken Tapered Roller type and seldom require adjustment. They are correctly adjusted at the factory by means of thin shims No. 4227 under the No. *5-A* bearing end plate. Should adjustment become necessary both bearings are adjusted simultaneously by removing the required number of shims from beneath the No. 5-A end plate. This adjustment must be made with care so that bearing will not be too tight.

b. To tighten connecting rod remove hand hole plate, cotter pins, and nuts from connecting rod, connecting rod cap, and shims. Peel off one shim and replace shims and cap making sure they are in the same position as before removal. They are marked to match rod. Tighten nuts and test for fit by turning crankshaft by hand. Insert new cotter pins and replace hand hole plate.

145. Valves

a. The valves are the vital parts of the compressor and should not be tampered with. An occasional inspection, about one every 2 months, to see that there is no excessive accumulation of carbon nor any broken parts, is all that is necessary. An occasional examination of suction unloader diaphragm 315-B or plunger 467 is also recommended.

b. If it is necessary to take a valve apart, note the manner in which the various parts are assembled and see that proper relation of parts is maintained in reassembling it. Be absolutely sure that plate valves are not pinched between seat and bumper so that they cannot lift. Test the valve action by inserting a screwdriver through the air ports. Each plate valve must lift and close freely. When replacing a valve see that seat gasket No. 4218 is in good shape. If the gasket is damaged install a new one.

c. Be sure to return each valve to its proper compartment. When replacing valve cover plates be sure that the adjusting screws are backed out sufficiently so that they will not engage when tightening cover plates on gaskets. After cover plate is down tight on the gasket, adjusting screws should be pulled down on clamp piece and locked in position by lock nut.

APPENDIX

REFERENCES

1. Miscellaneous

a. Department of the Army Supply Manual TC 7, 8, & 9 L-13 & L-48 for Organizational Field and Depot Maintenance Allowances and List of All Service Parts.

b. TM 55-270, Operation of Railroads, General Instructions for the Inspection and Maintenance of Locomotives and Locomotive Cranes.

c. TM 55-271, Operation of Railroads, Diesel Electric Locomotives.

d. TM 55-405, Preventive Maintenance of Electric Motors and Generators.

e. TM 55-1001, Engine, Marine, Diesel, Cummins Model "H" Series.

f. TM 55-2022, Brake Equipment Air, Railway Locomotive, NYABCO Model 14EL, Instruction Pamphlet No. 41, Sup. 1.

g. LO 55-1268, Locomotive, Diesel-Electric, $56^{1}/2$ in. gage, 23 Ton and 25 Ton 0-4-0, 150 HP, General Electric.

h. LO 55-1001, Engine, Diesel, Cummins HSC-600.

2. Standard Forms and Records

a. DD Form 438-1, Railway Equipment Report-Motive Power Other Than Steam. Part I-Registry, Assignment, and Service Record.

b. DD Form 438-5, Railway Equipment Report Part II-Semi-Annual Service and Maintenance.

c. DA Form 55-115, Daily Assignment Worksheet for Locomotives and Locomotive Cranes.

d. DA Form 55-225, Weekly Shop Report of Railroad Equipment.

e. DA Form 55-226, Daily Inspection Report Locomotives and Locomotive Cranes.

f. DA Form 55-230, Monthly Inspection and Repair Report of Locomotives and Locomotive Cranes other than Steam.

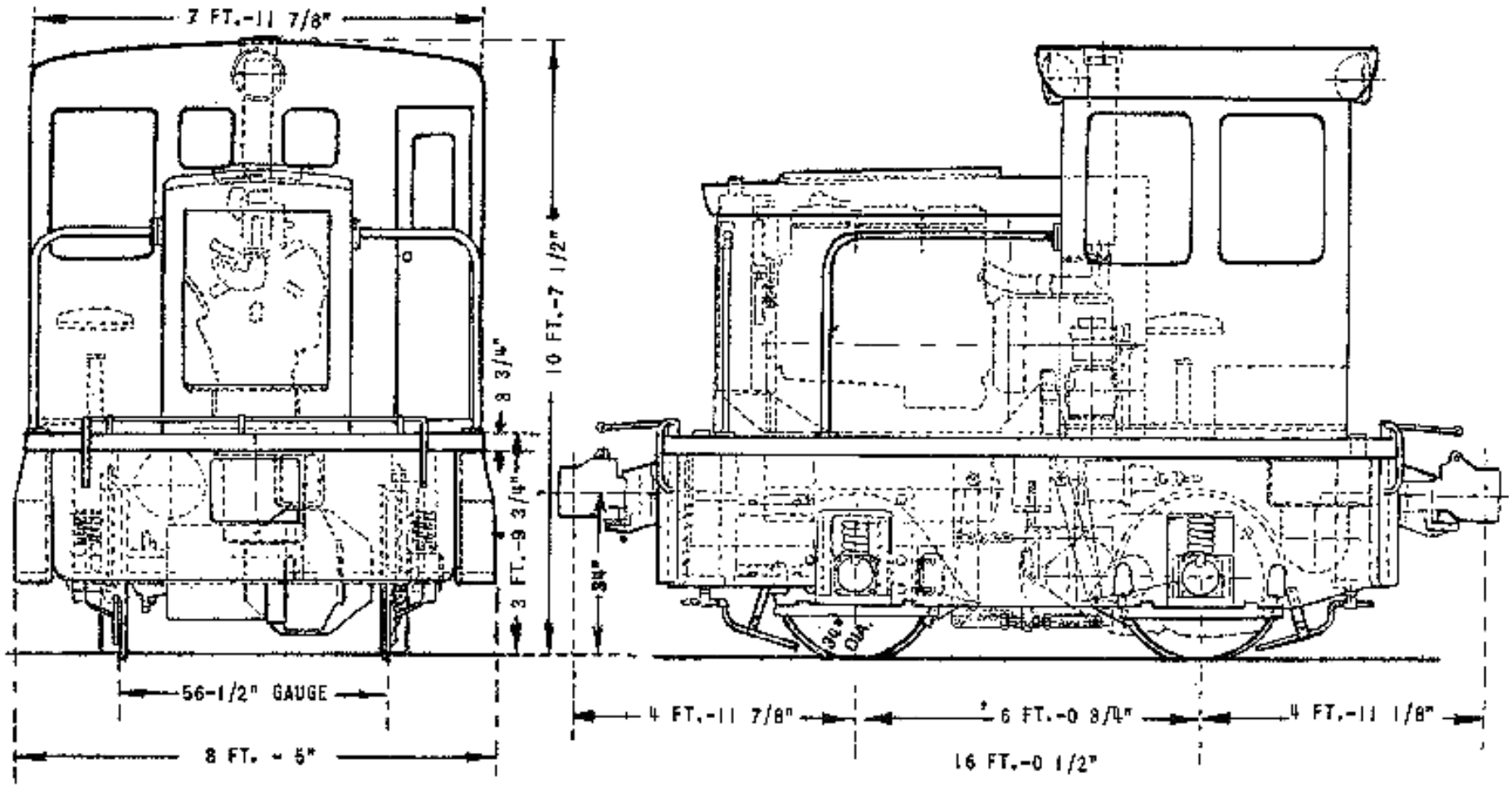
g. DA Form 55-235, Locomotive Inspection, Cleaning and Test Record.

h. DA Form 55-236, Locomotive Specification card.

i. DA Form 5-83, Motor or Generator Record Card.

j. DA Form 5-89, Worksheet for Motors or Generators and Preventive Maintenance Service.

k. DD Form 110, Vehicle and Equipment Operational Record.



ASSEMBLY-SIDE AND END-WW 6799312
TCSCO 10101

Figure 1. Assembly side and end.

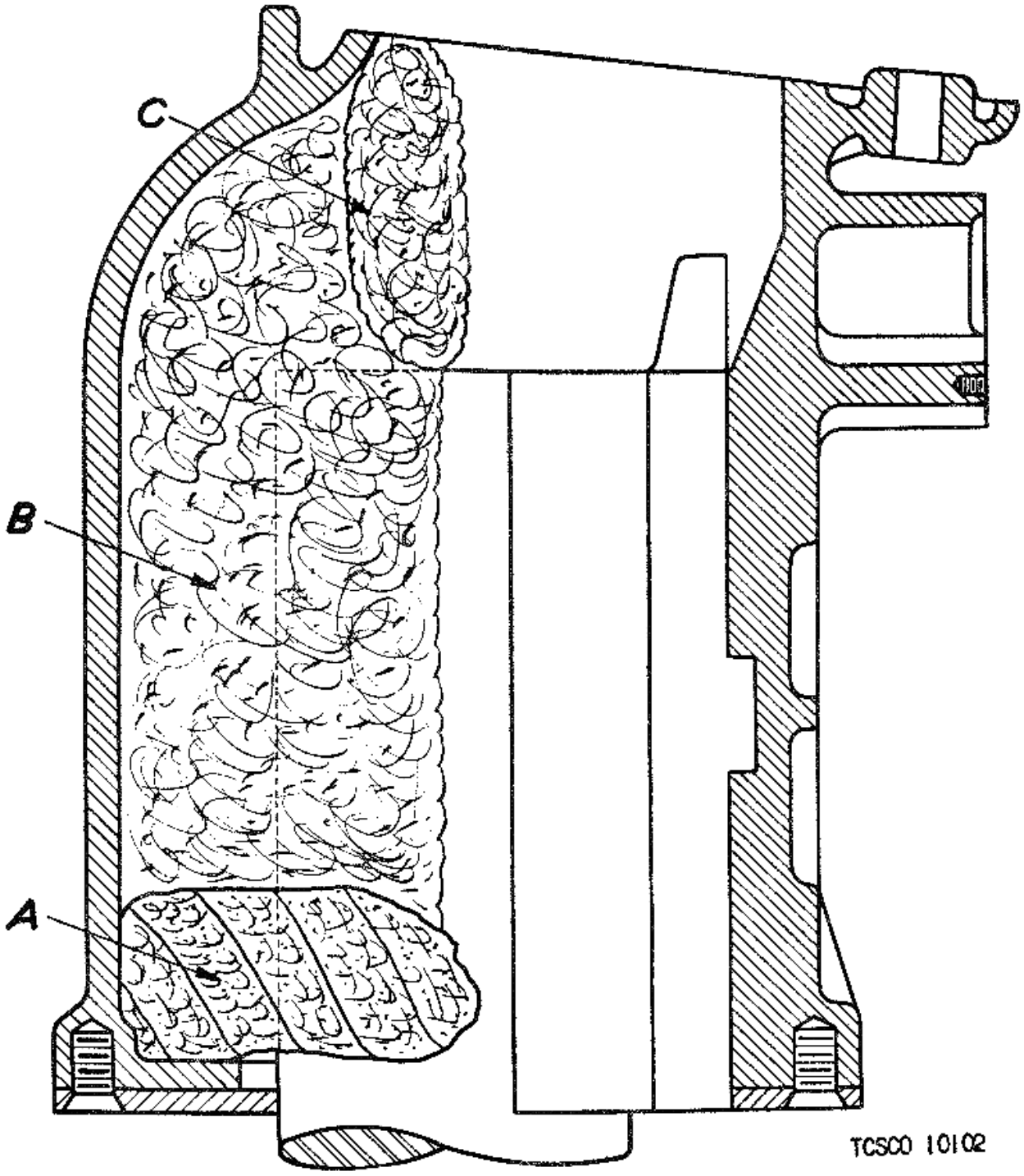


Figure 2. Packing locomotive journal boxes.

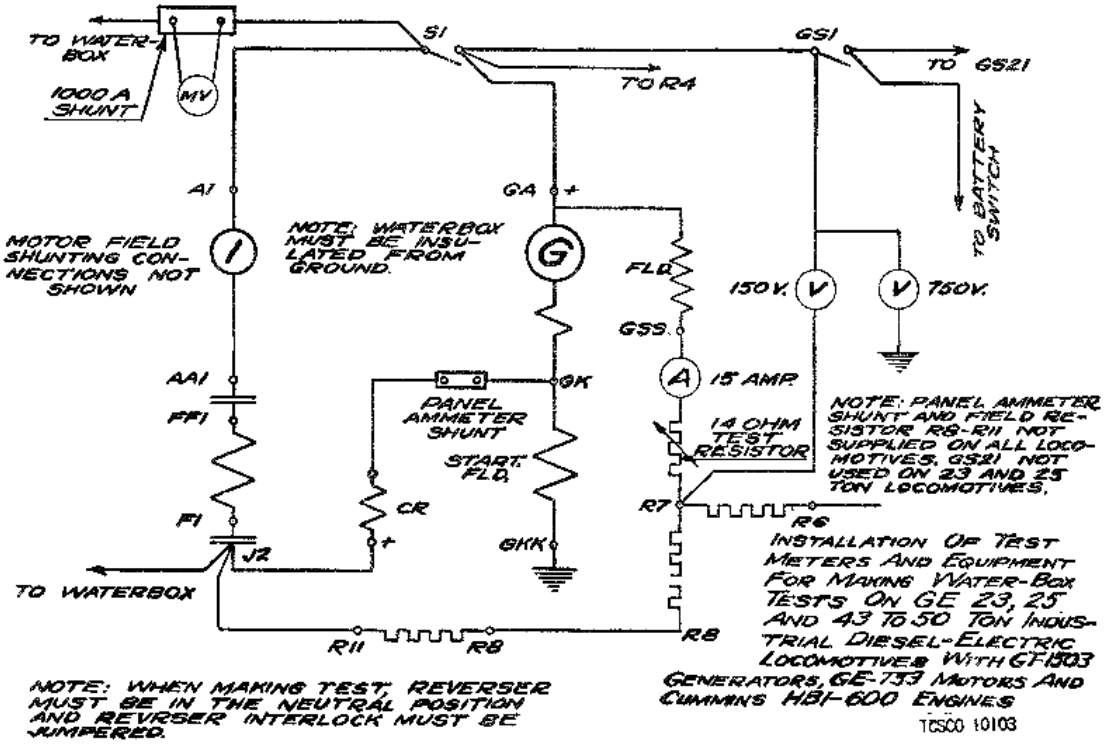


Figure 3. Test meters and equipment for water-box tests.

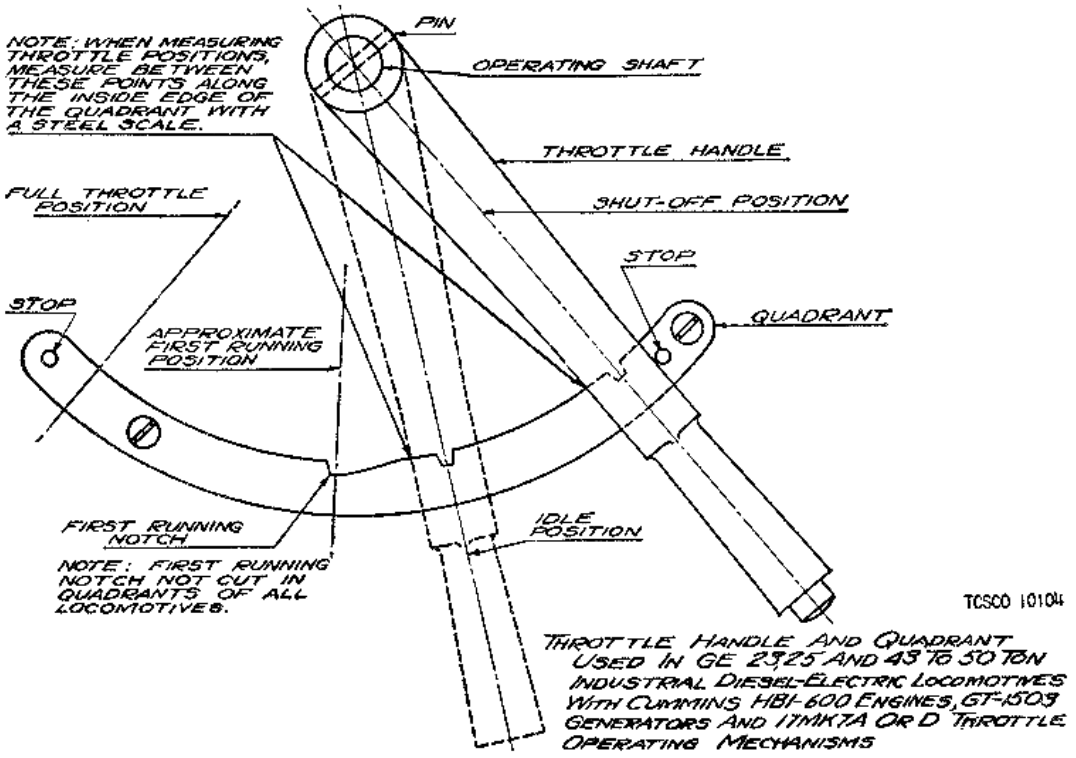


Figure 4. Throttle handle and quadrant.

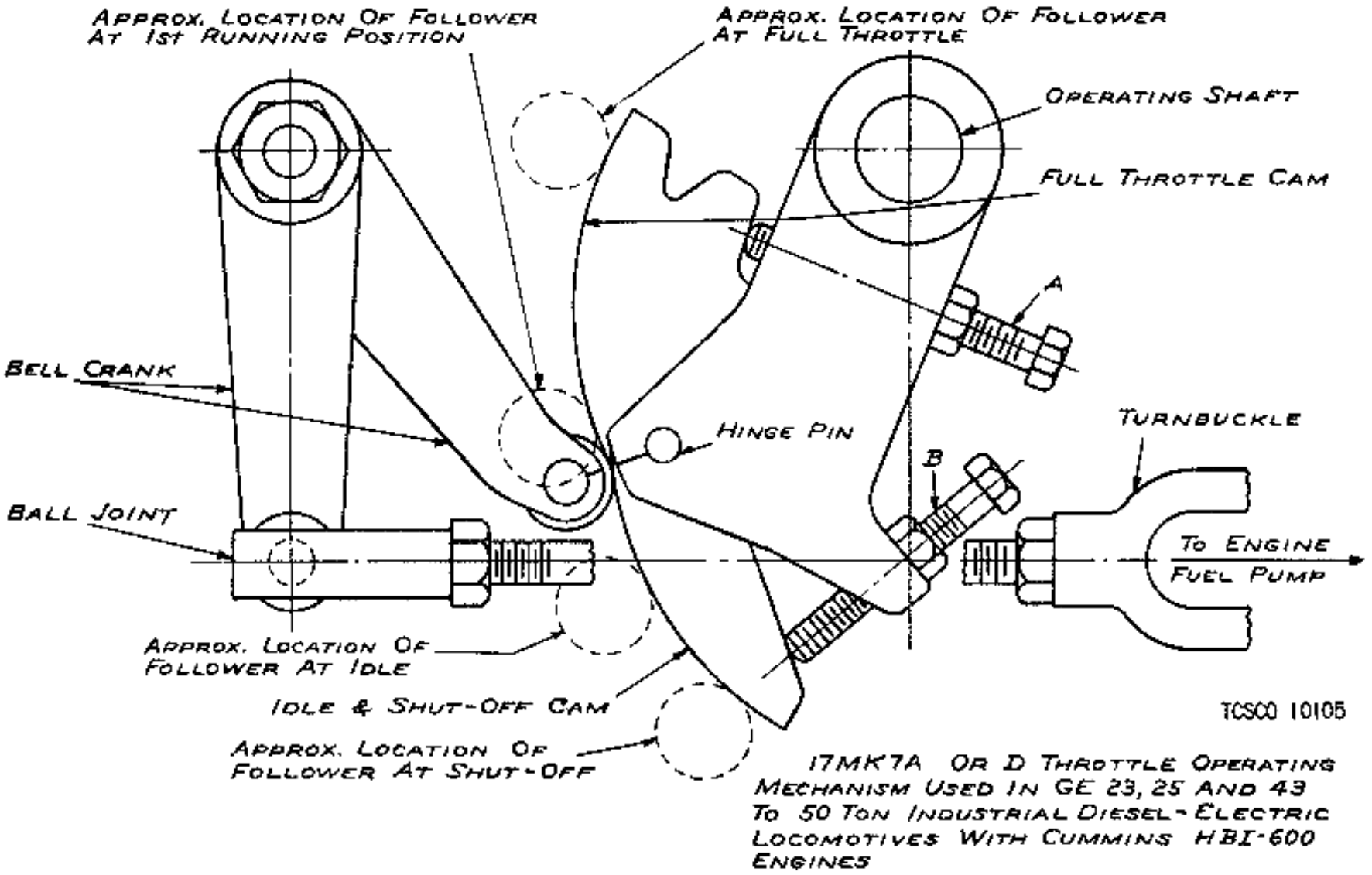


Figure 5. Throttle operating mechanism 17MK7A or D.

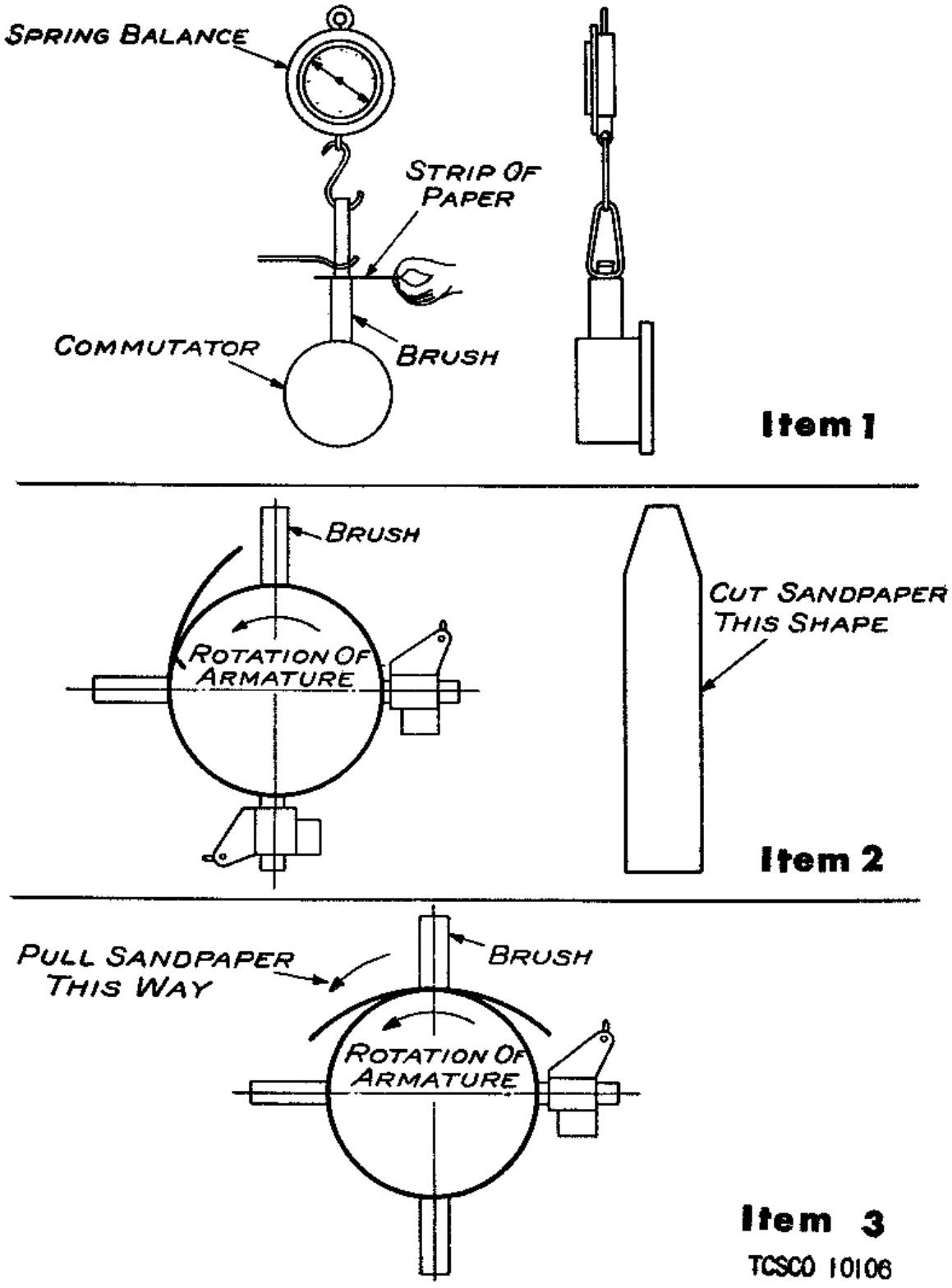


Figure 6. Sanding and obtaining brush pressure.

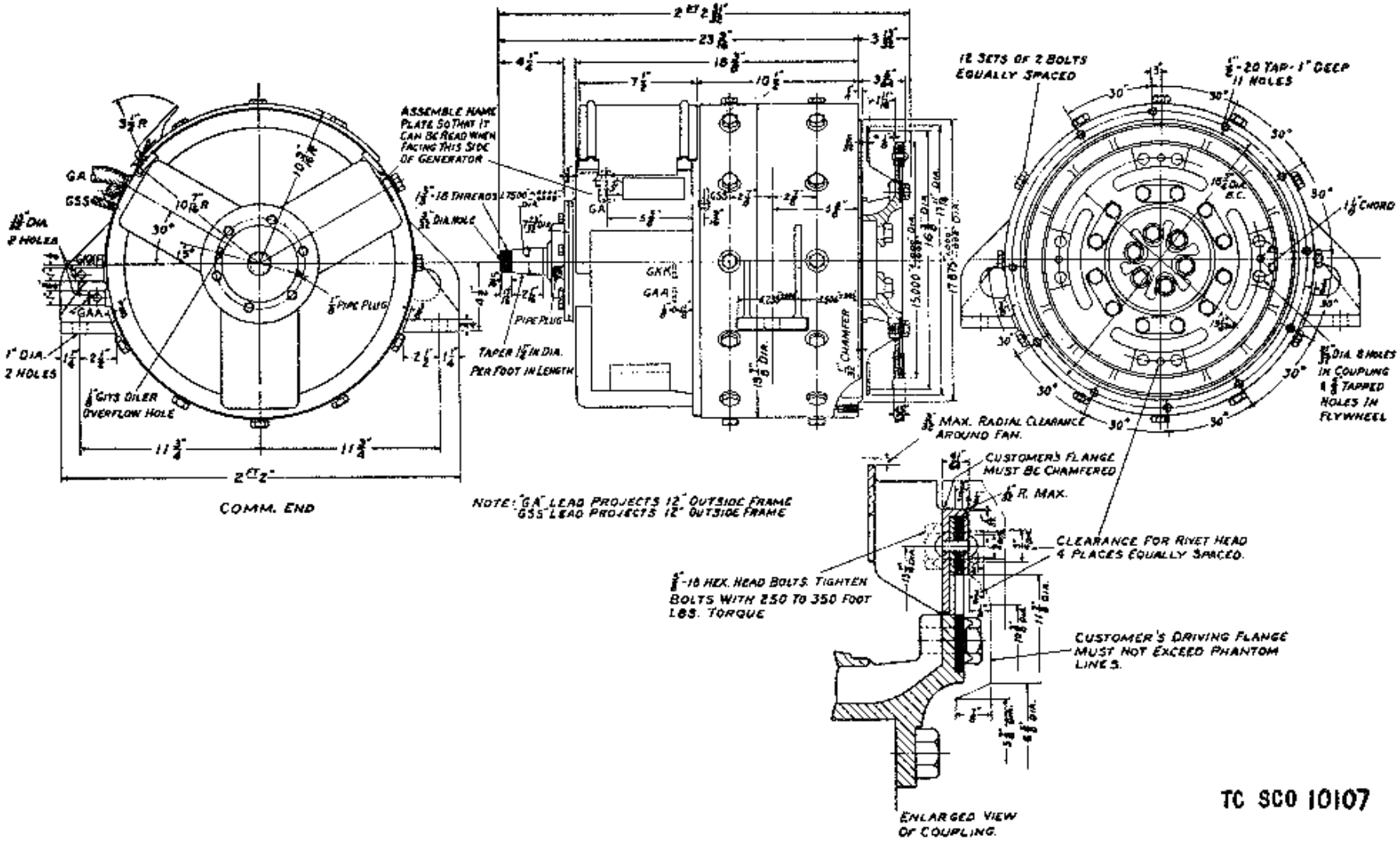
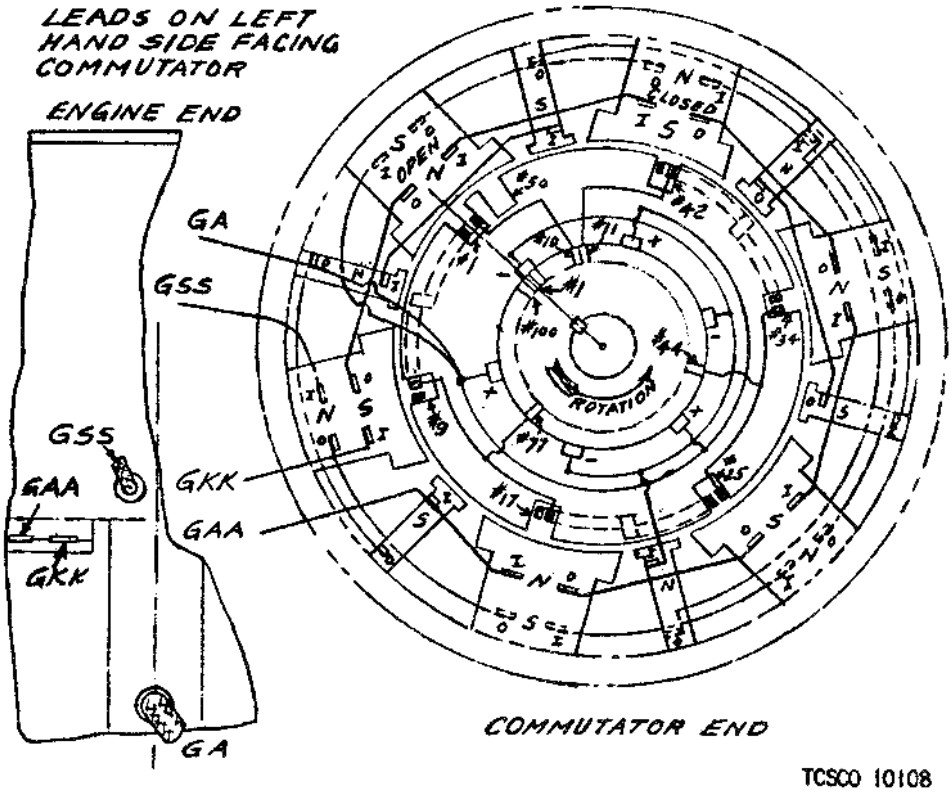


Figure 7. Generator outline GT-1503-X.



GENERATOR	TURNS	ARMATURE COIL	EXCITING FIELD	COMMUTATING FIELD
GT-1503 S-1	.1	CAT. 4744859 G1	CAT. 4748413 G1 OPEN CAT. 4748532 G1 CLOSED	CAT. 4748412 G1

Figure 8. Connection diagram GT-1508-S.

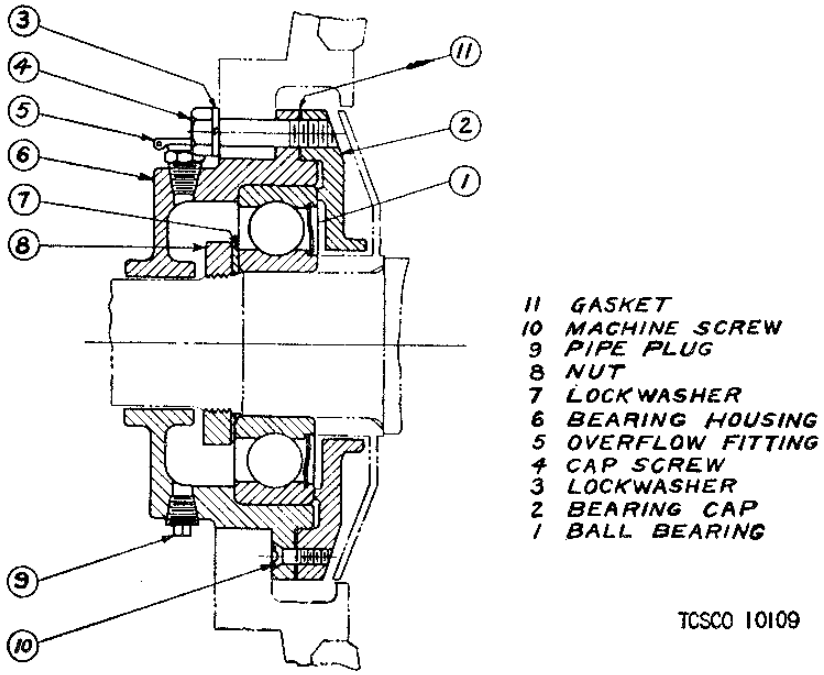


Figure 9. Bearing assembly, generator GT-1501. TAGO 4484A

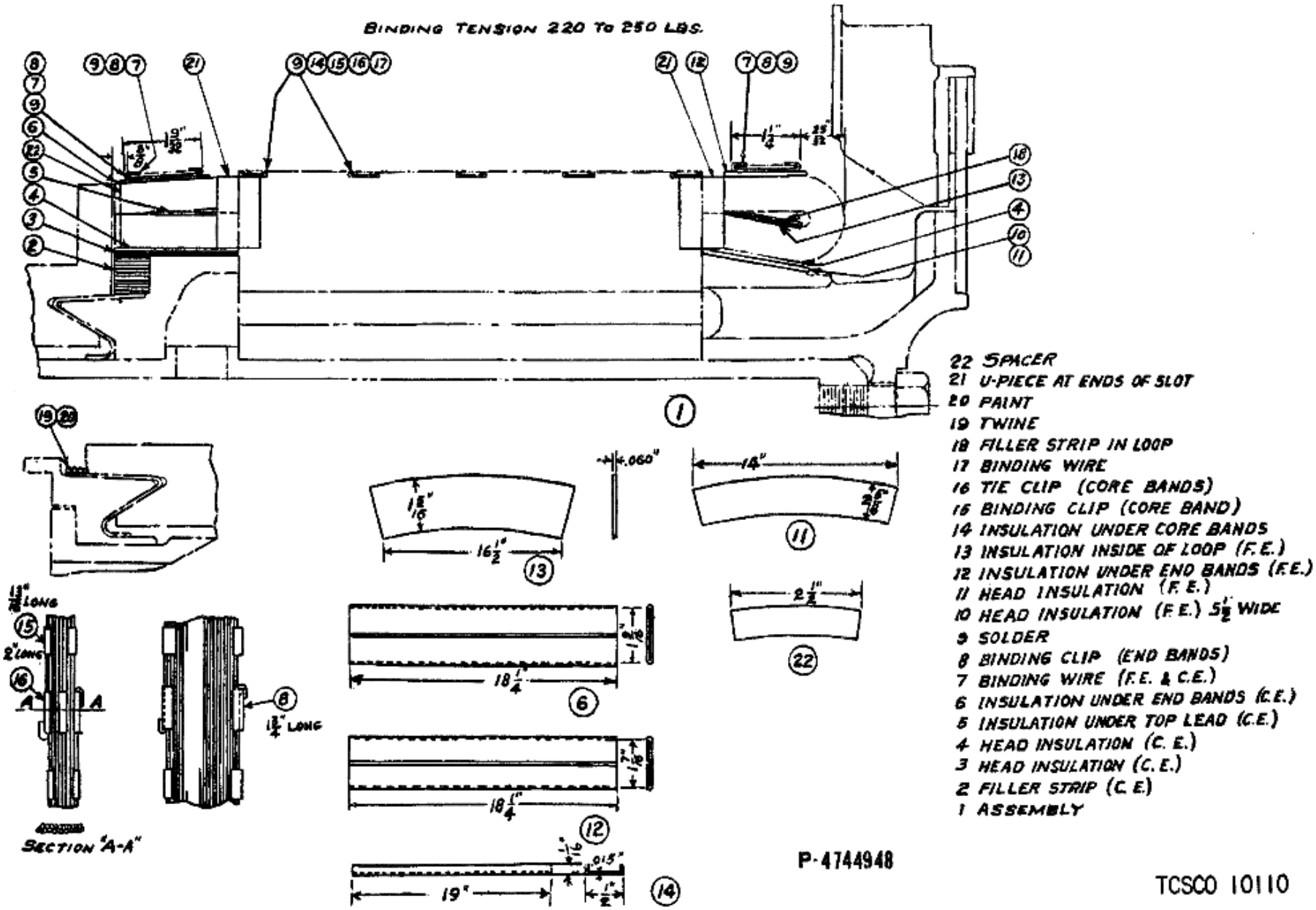


Figure 10. Armature insulation, generator GT-1503.

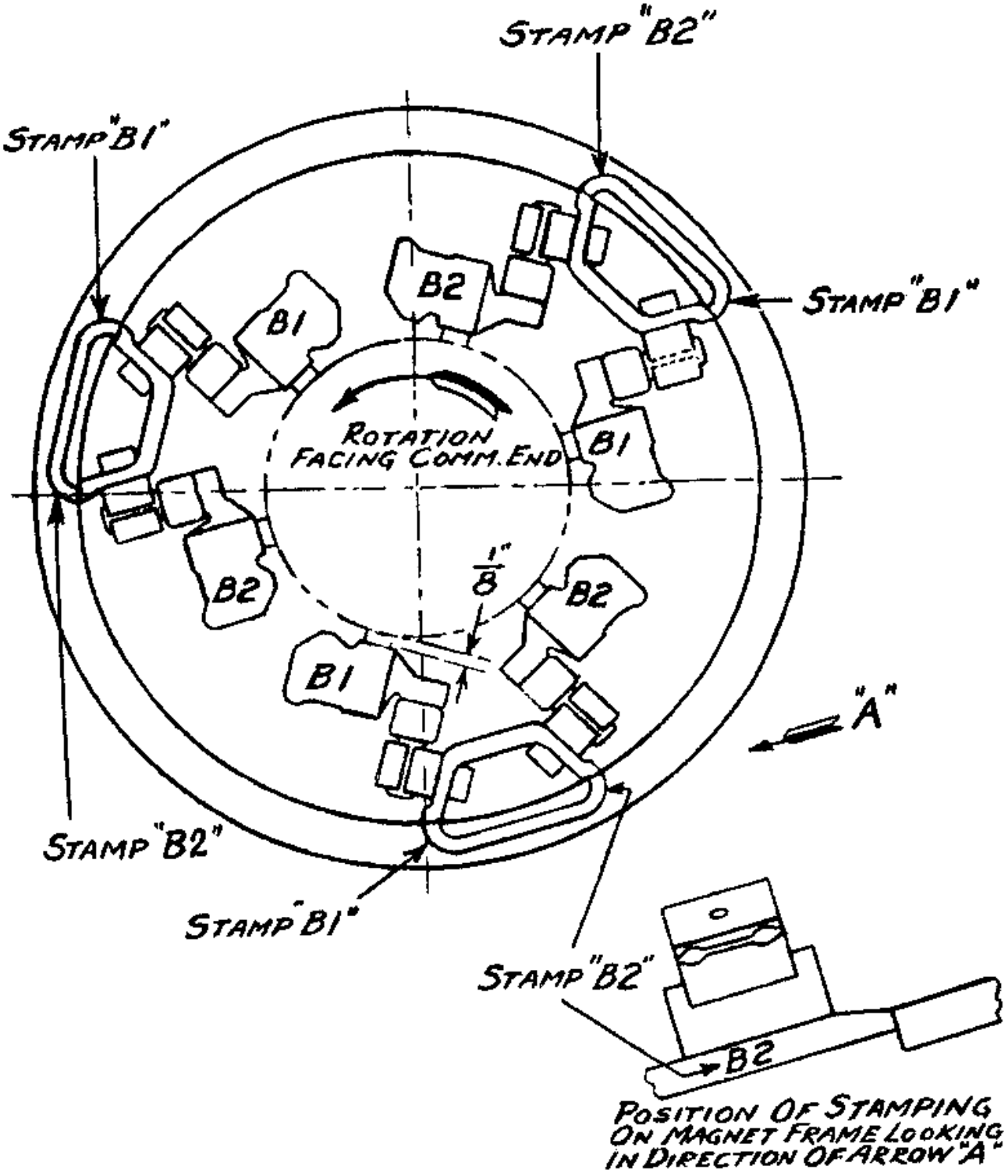


Figure 11. Brush holder location diagram GT-1501-P.

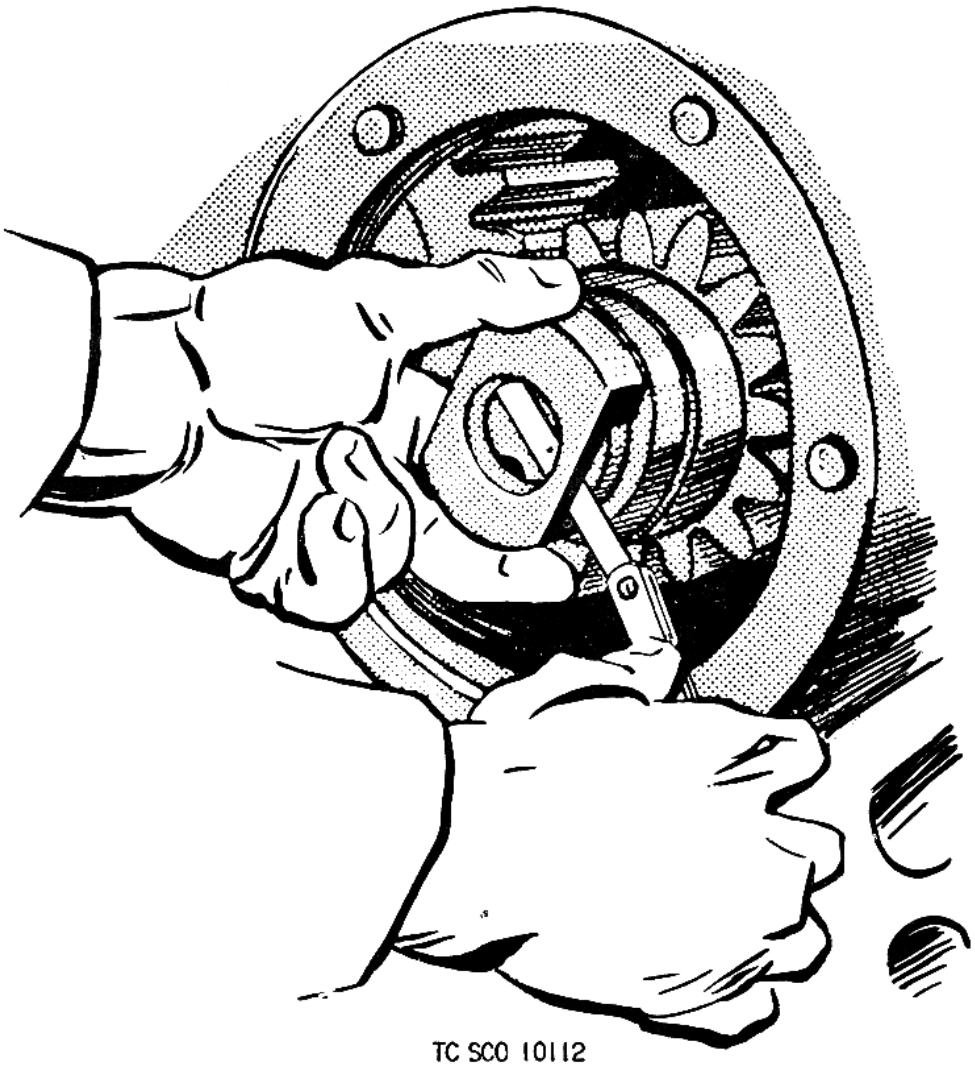


Figure 12. Pinion-Advance Gage, traction motor, Type GE-783.

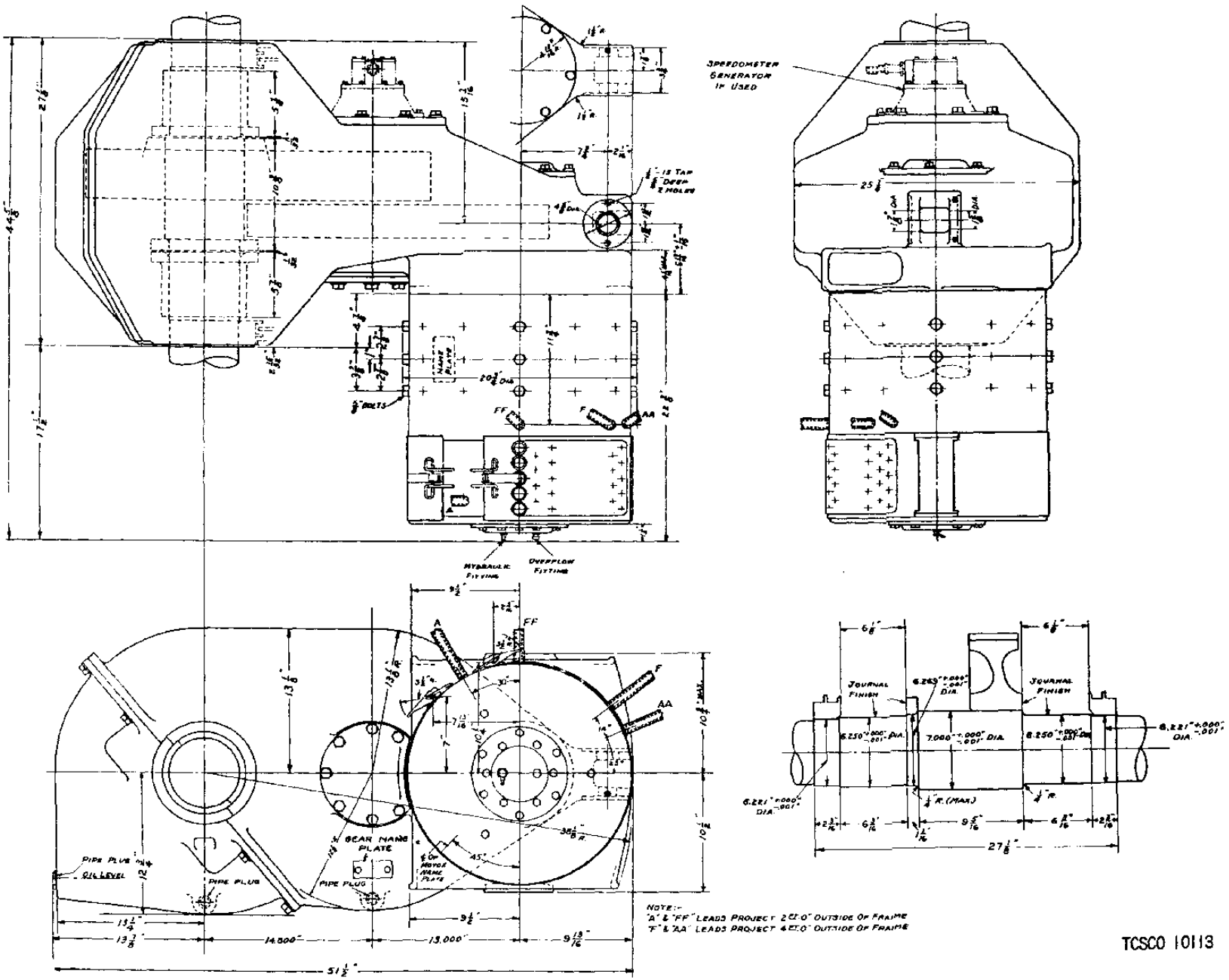
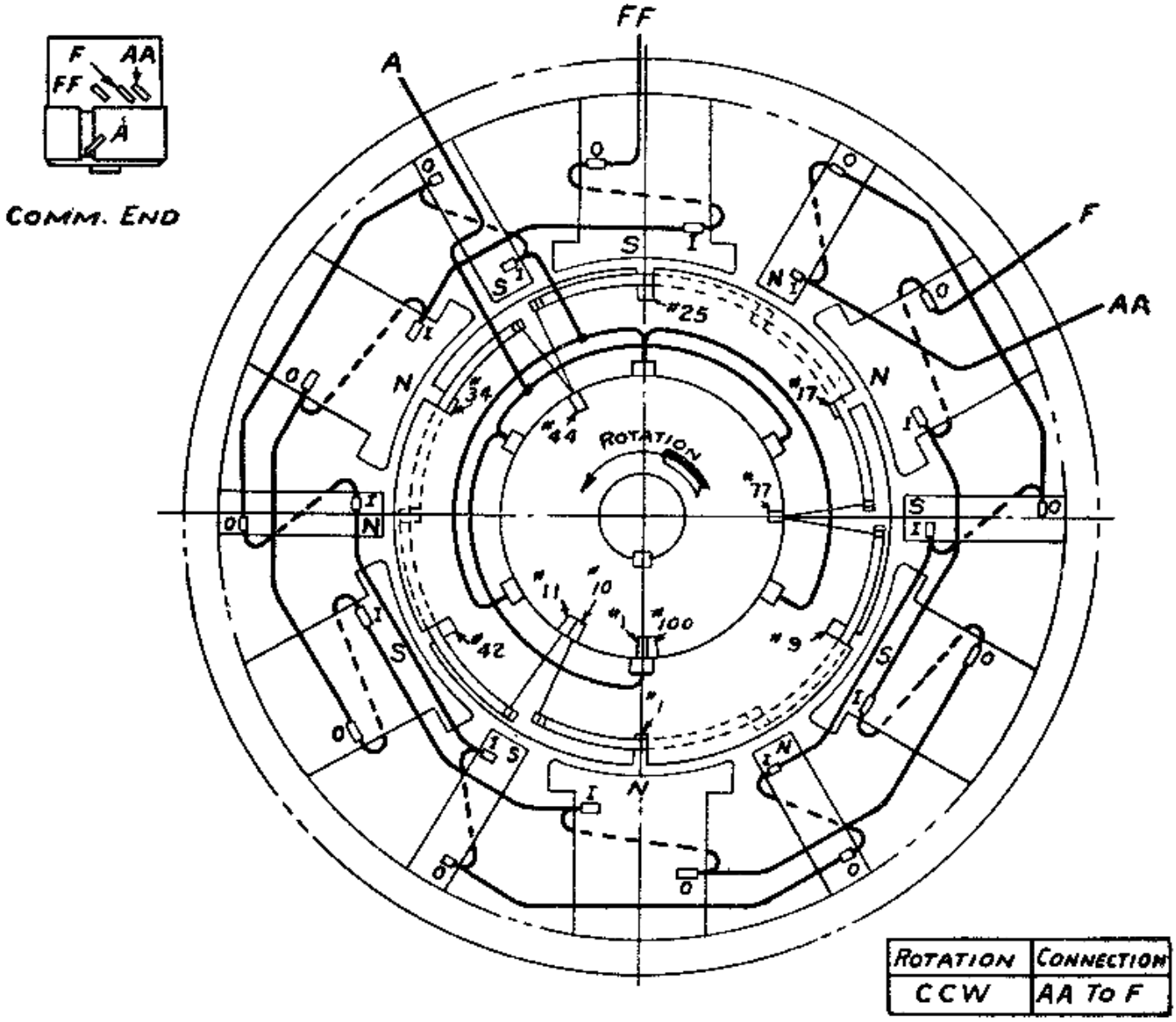


Figure 13. Railway gear reduction unit GA-33-C, outline.



MOTOR	TURNS	ARMATURE COIL	EXCITING FIELD & POLE	COMMUTATING FIELD & POLE
GE-733	1	CAT. 4748334G1	CAT. 4748332G1	CAT. 4748337G1
GE-733	1	CAT. 4748334G1	CAT. 4748332 G3	CAT. 4748337 G3

Figure 14. Connection diagram, motor GE-733.

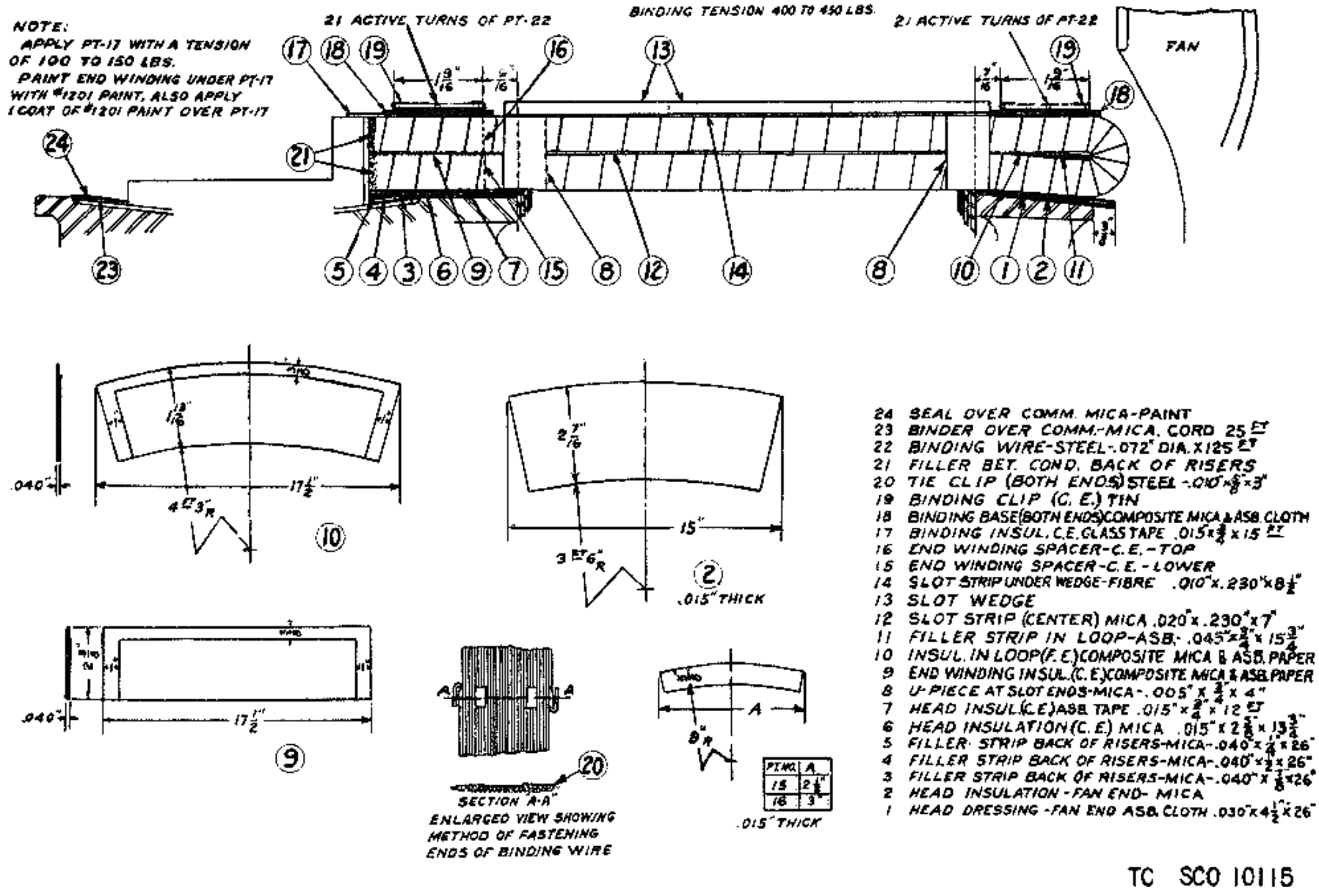


Figure 15. Armature insulation motor GE-733.

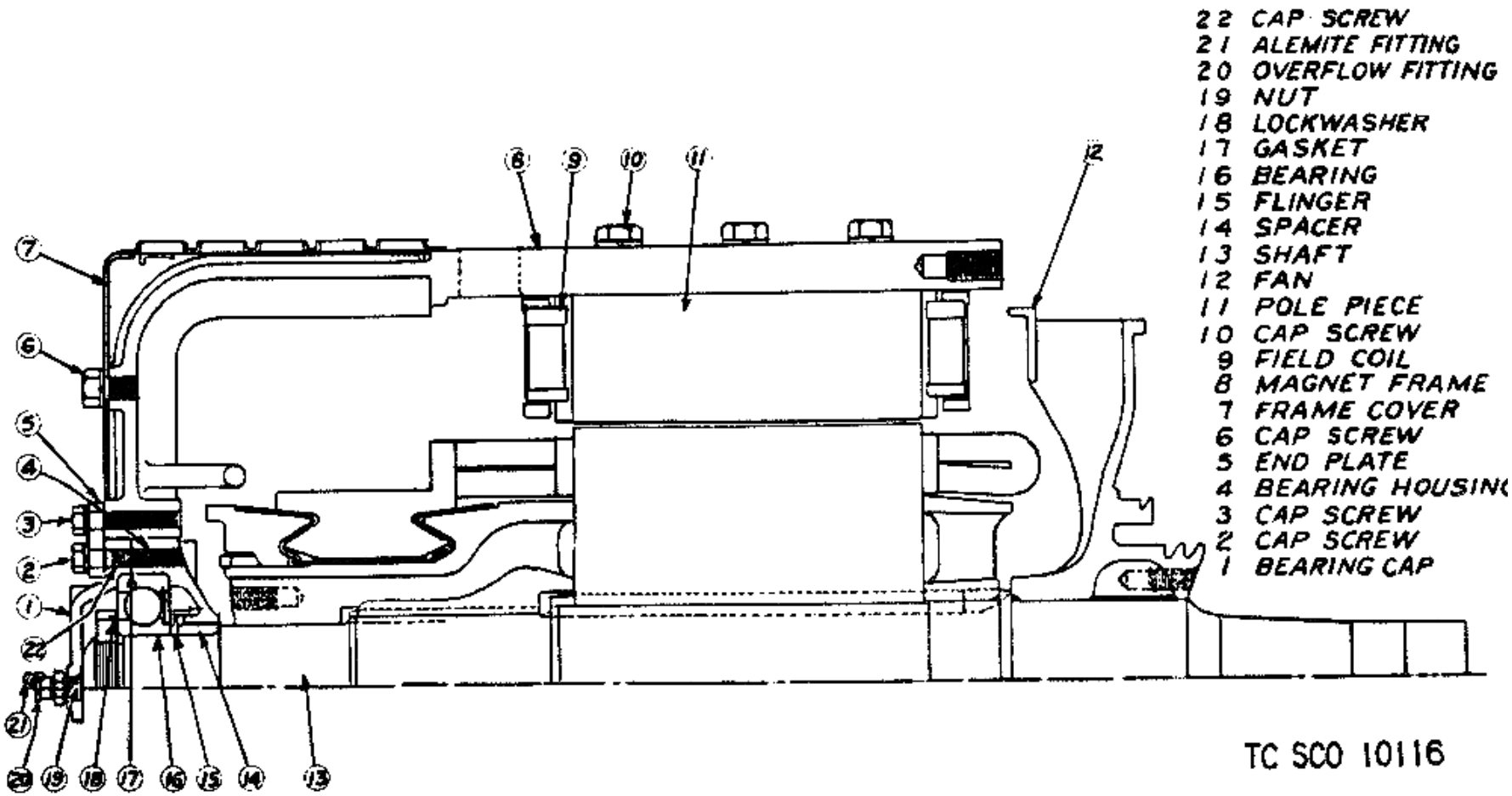
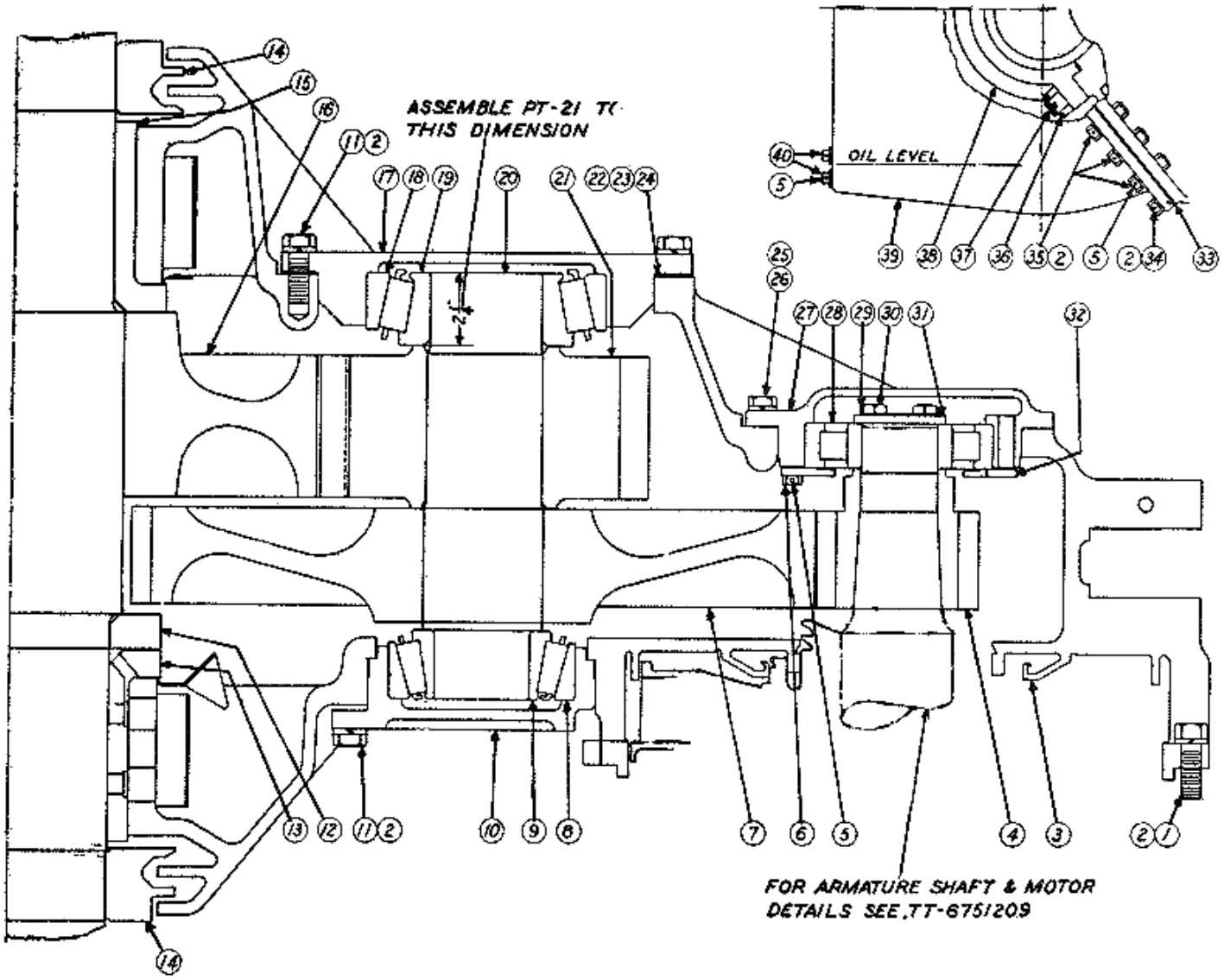


Figure 16. Longitudinal section, motor GE-733-A.



40 PIPE PLUG
39 COVER
38 AXLE CAP
37 COTTER PIN
36 NUT
35 CAPSCREW
34 CAPSCREW 33 GASKET
32 RETAINER RING
3/ RETAINER PLATE
30 CAPSCREW
29 LOCKWASHER
28 ROLLER BEARING
27 BEARING HOUSING
26 CAPSCREW
25 LOCKWASHER
24 SHIM
23 SHIM
22 SHIM
21 PINION LOW SPEED
20 INTERMEDIATE SHAFT
19 TIMKEN BEARING - CONE
18 TIMKEN BEARING - CUP
17 BEARING HOUSING
16 GEAR LOW SPEED
15 AXLE LINING
14 FLINGER
13 AXLE LINING
12 COLLAR
11 CAPSCREW
10 BEARING HOUSING
9 TIMKEN BEARING - CONE
8 TIMKEN BEARING - CUP
7 GEAR HIGH SPEED
6 CAPSCREW
5 WIRE
4 PINION HIGH SPEED
3 GEAR BOX
2 LOCKWASHER
1 CAPSCREW

Figure 17. Gear box assembly, -motor GE-733

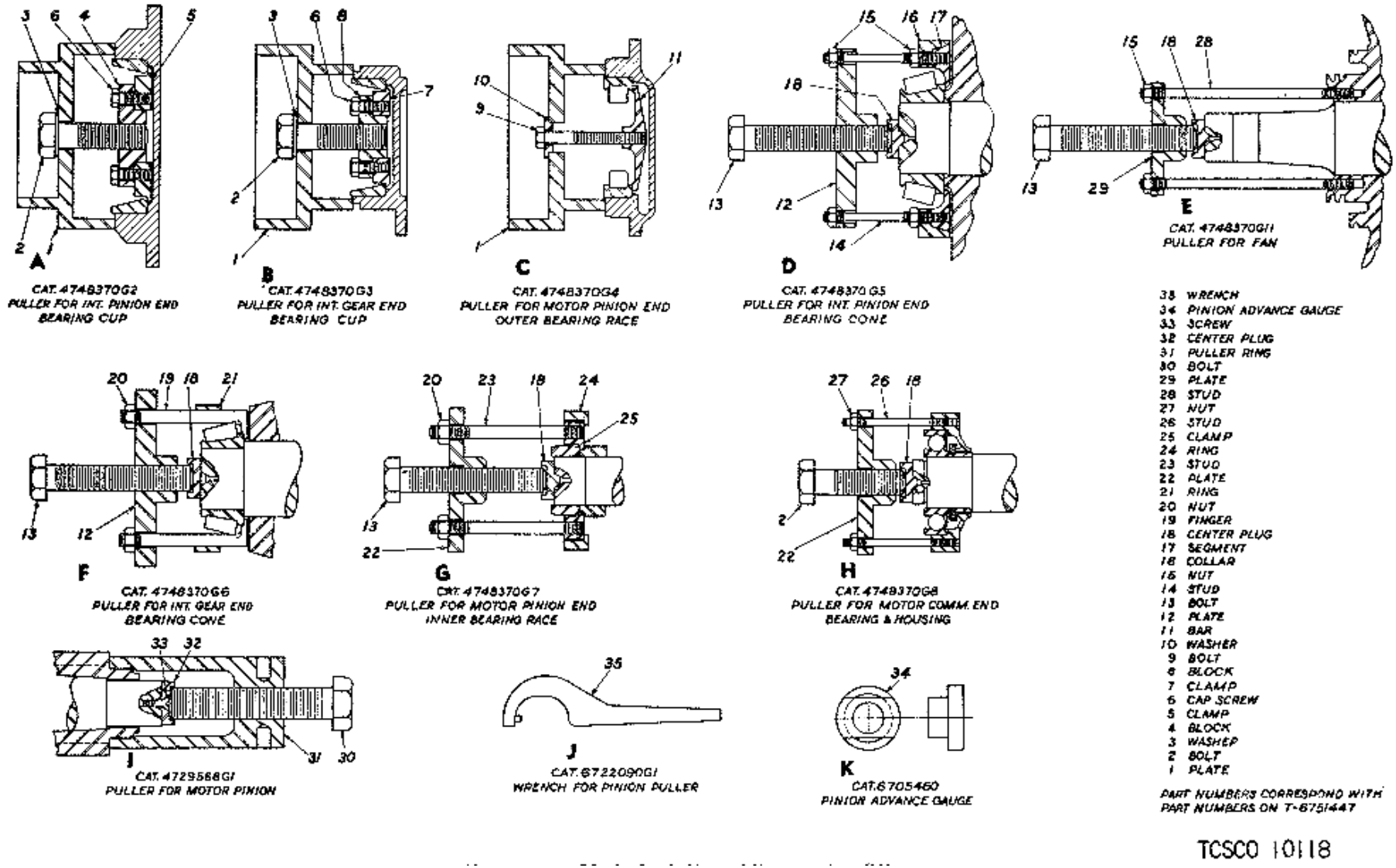


Figure 18. Method of dissembling, motor GE-733.

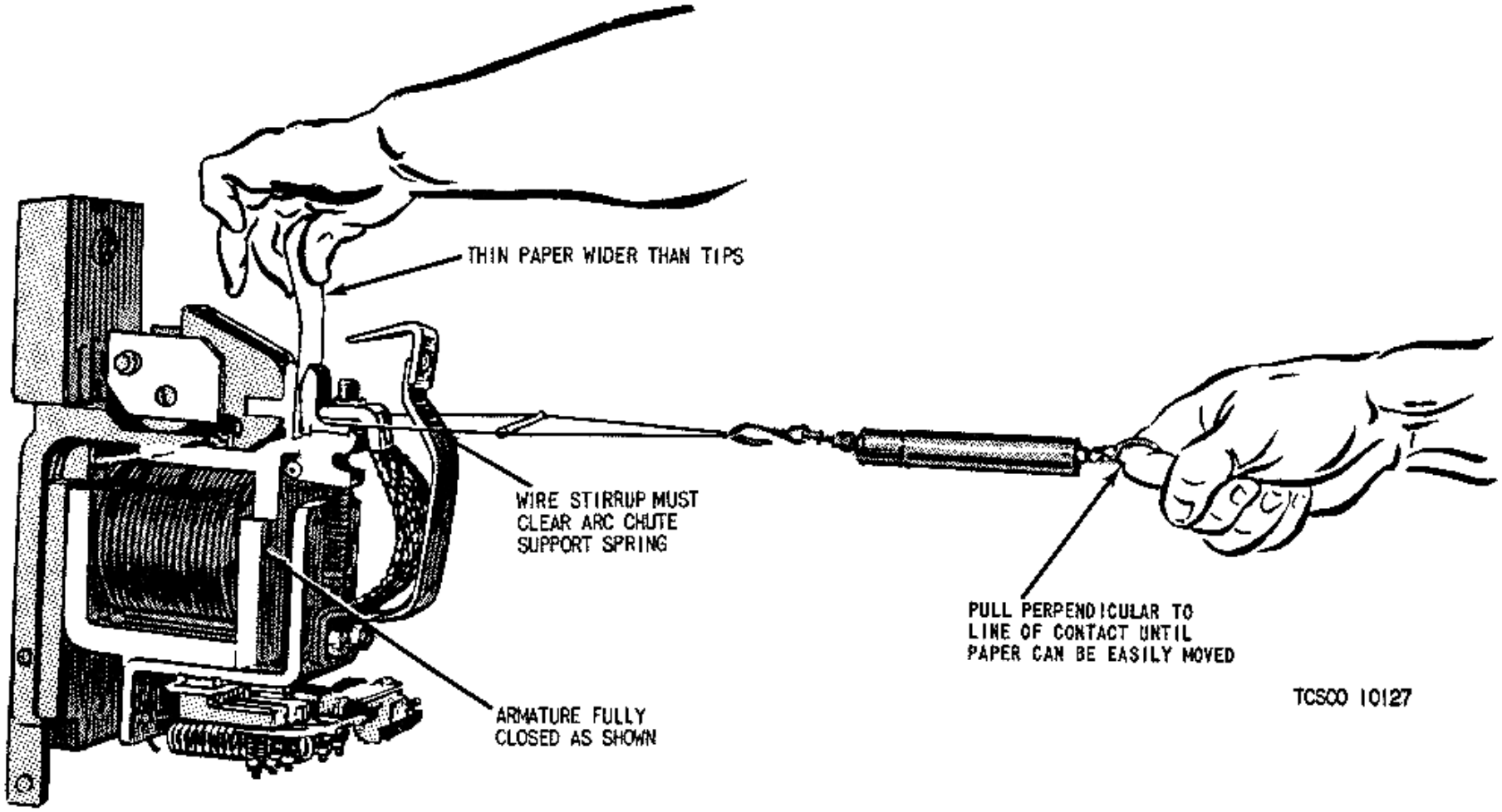
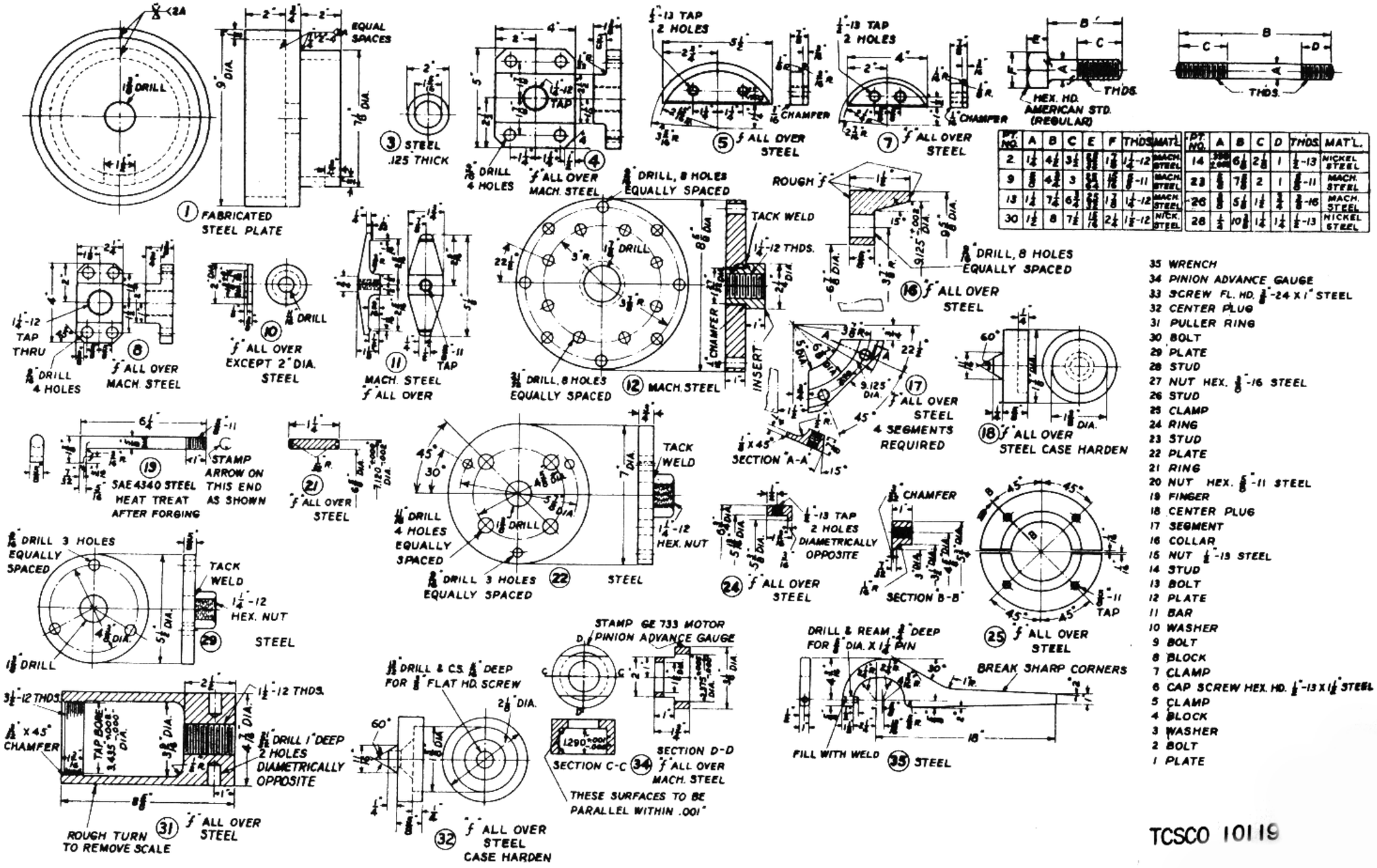


Figure 20. Method of measuring final contact tip pressure.



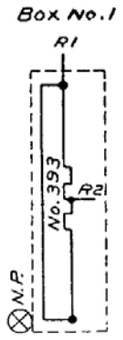
PT. NO.	A	B	C	E	F	THDS.	MAT'L.
2	1 1/2	4 1/2	3 1/2	5/8	1 1/8	1 1/4-12	MACH. STEEL
9	5/8	4 1/2	3	5/8	1 1/8	1 1/8-11	MACH. STEEL
13	1 1/2	7 1/4	6 1/2	5/8	1 1/8	1 1/4-12	MACH. STEEL
30	1 1/2	8	7 1/2	1 1/16	2 1/4	1 1/4-12	NICK. STEEL

PT. NO.	A	B	C	D	THDS.	MAT'L.
14	.998/1.000	6 1/8	2 1/8	1	1/2-13	NICKEL STEEL
23	5/8	7 1/8	2	1	5/8-11	MACH. STEEL
26	5/8	5 1/8	1 1/2	3/4	5/8-16	MACH. STEEL
28	1/2	10 1/8	1 1/2	1 1/2	1/2-13	NICKEL STEEL

35 WRENCH
34 PINION ADVANCE GAUGE
33 SCREW FL. HD. 1/4-24 X 1" STEEL
32 CENTER PLUG
31 PULLER RING
30 BOLT
29 PLATE
28 STUD
27 NUT HEX. 5/8-16 STEEL
26 STUD
25 CLAMP
24 RING
23 STUD
22 PLATE
21 RING
20 NUT HEX. 5/8-11 STEEL
19 FINGER
18 CENTER PLUG
17 SEGMENT
16 COLLAR
15 NUT 1/2-13 STEEL
14 STUD
13 BOLT
12 PLATE
11 BAR
10 WASHER
9 BOLT
8 BLOCK
7 CLAMP
6 CAP SCREW HEX. HD. 1/2-13 X 1 1/2 STEEL
5 CLAMP
4 BLOCK
3 WASHER
2 BOLT
1 PLATE

TCSCO 10119

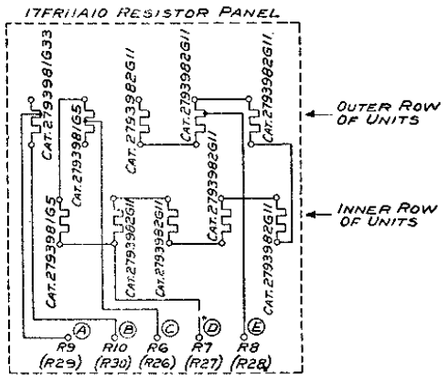
MISC. PARTS	Box No.	
CATALOG NO.	Quantity	
274399964	1	
743999P4	2	
2743999P5	2	
2743339P6	2	
2/D424G1	1	
4703354	2	



RESISTANCE VALUE
R1 - R2 = .0110 OHM ± 5% NOTE: Clips 4703534 To be assembled adjacent to resistor Unit Supports as on P-2743556

BOX No. 1- 17EW101A2, OUTLINE 1f- 2765124
(Expect Clips 4 4703534 Permit Mounting With Supports UP & Terminals Down)
TCSCO 10121

Figure 21. Field shunting resistor, connection diagram.



APPROXIMATE RESISTANCE

R6 - R7	=	14.0 Ohms
R7 - R8	=	13.5 Ohms
R9 – RIO	=	30.0 Ohms
R26- R07	=	14.0 Ohms
R27- R28	=	13.5 Ohms
R29 - R30	=	30.0 Ohms

NOTE
WHERE INTERNAL CONNECTIONS ARE MADE TO THE ADJUSTABLE SLIDER TERMINALS, THE CONNECTING WIRES SHOULD SE MADE LONG ENOUGH SO THAT THE SLIDER MAY BE MOVED TO ANY POINT ON THE TUBE TO WHICH IT IS ATTACHED, OR TO ANY POINT ON THE NEXT TUBE ON EITHER SIDE.

Figure 22. Resistor panel 17FR11A10, connection diagram.

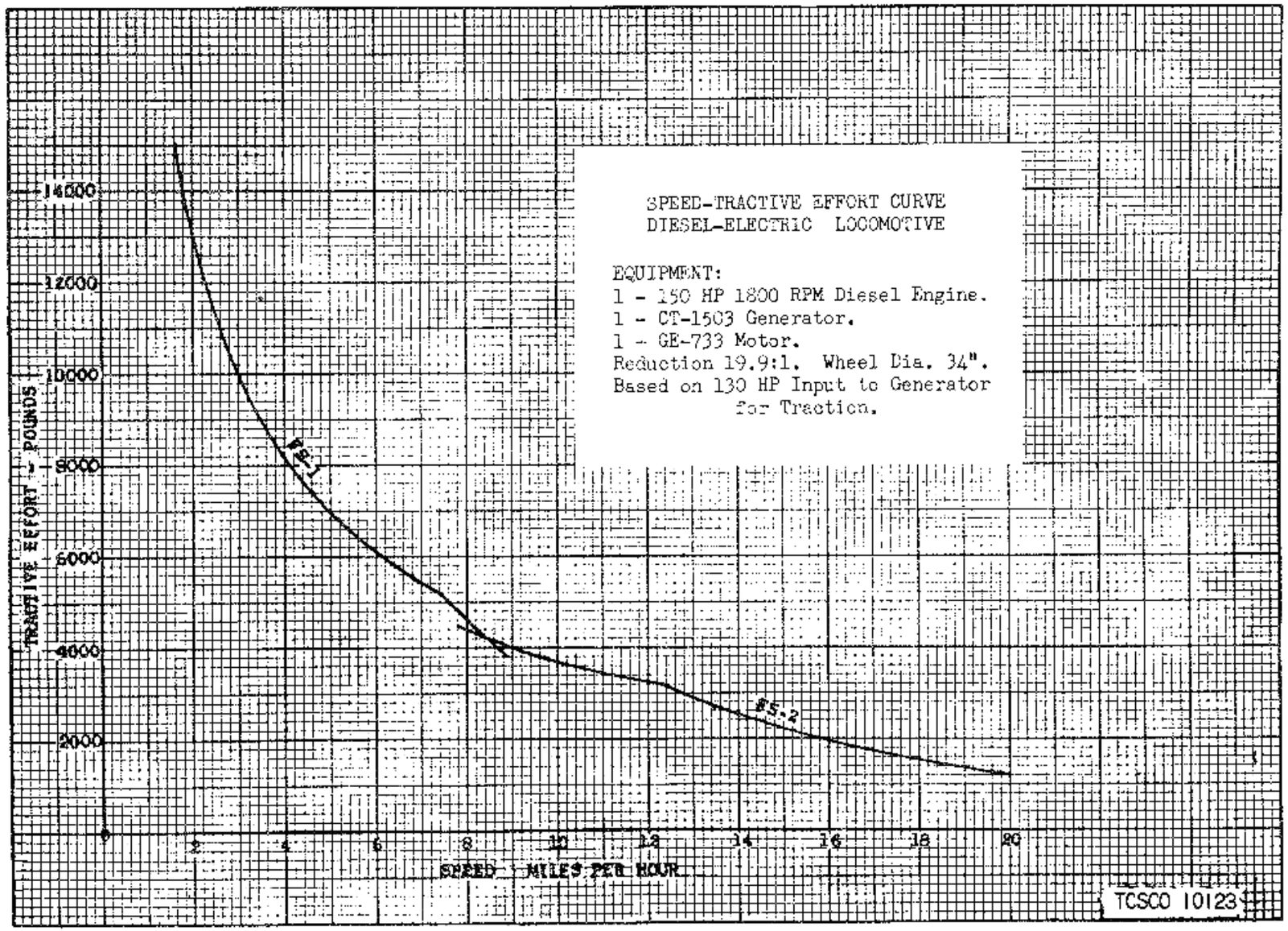


Figure 23. Speed-traction effort curve.

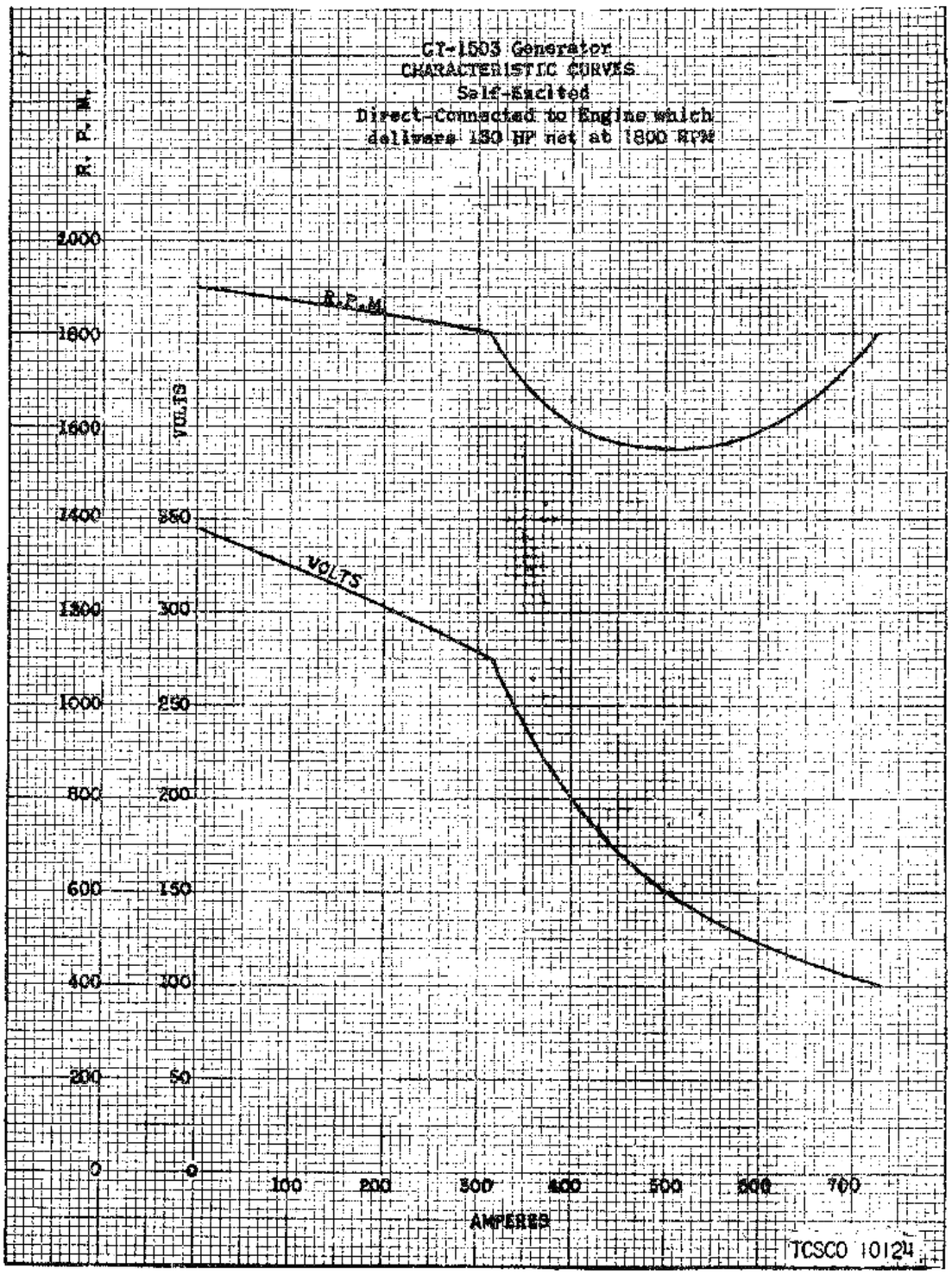


Figure 24. Characteristic curves, GT-1503 generator.

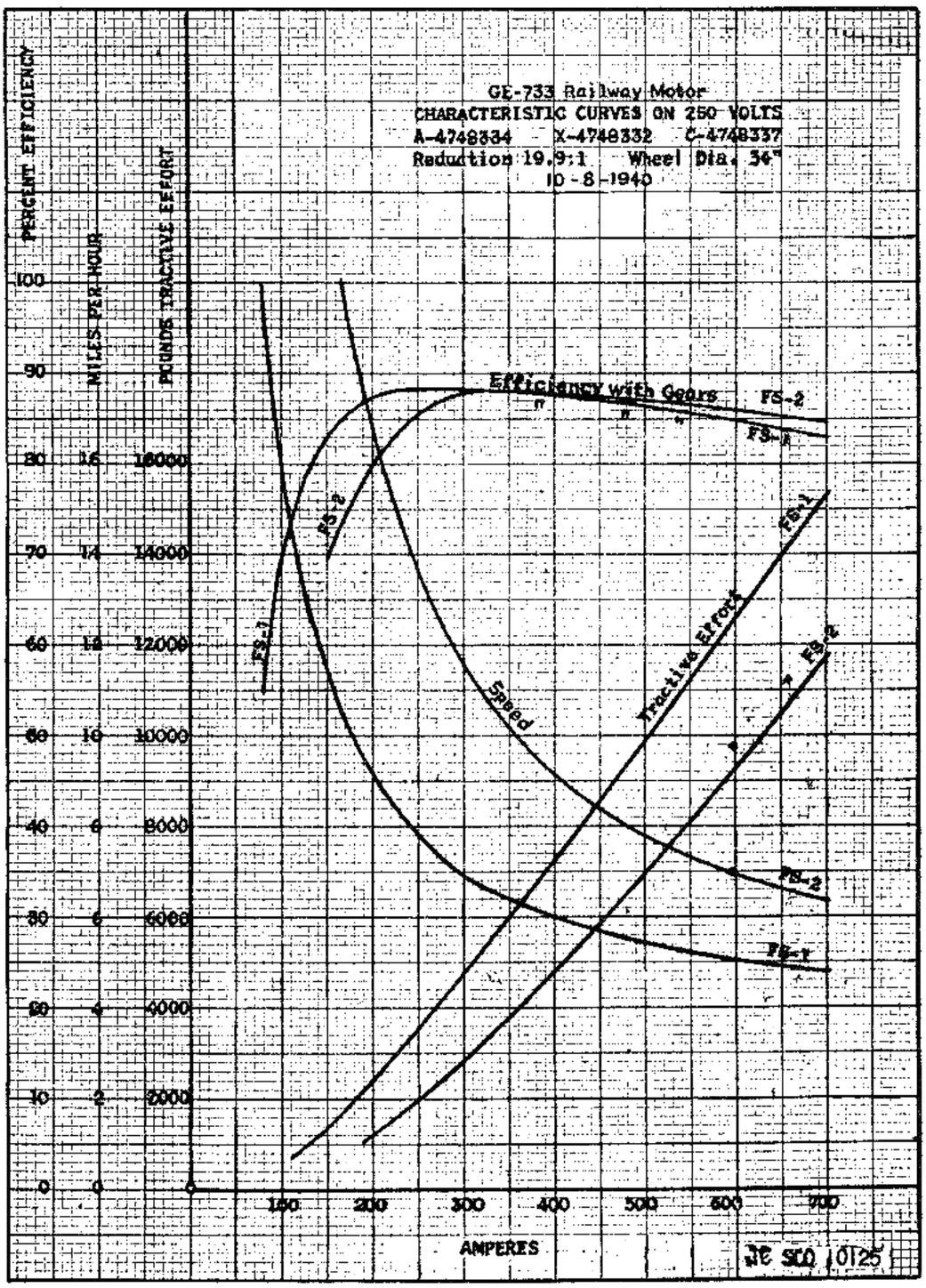


Figure 25. Characteristic curves, 250V, GE-733 motor.

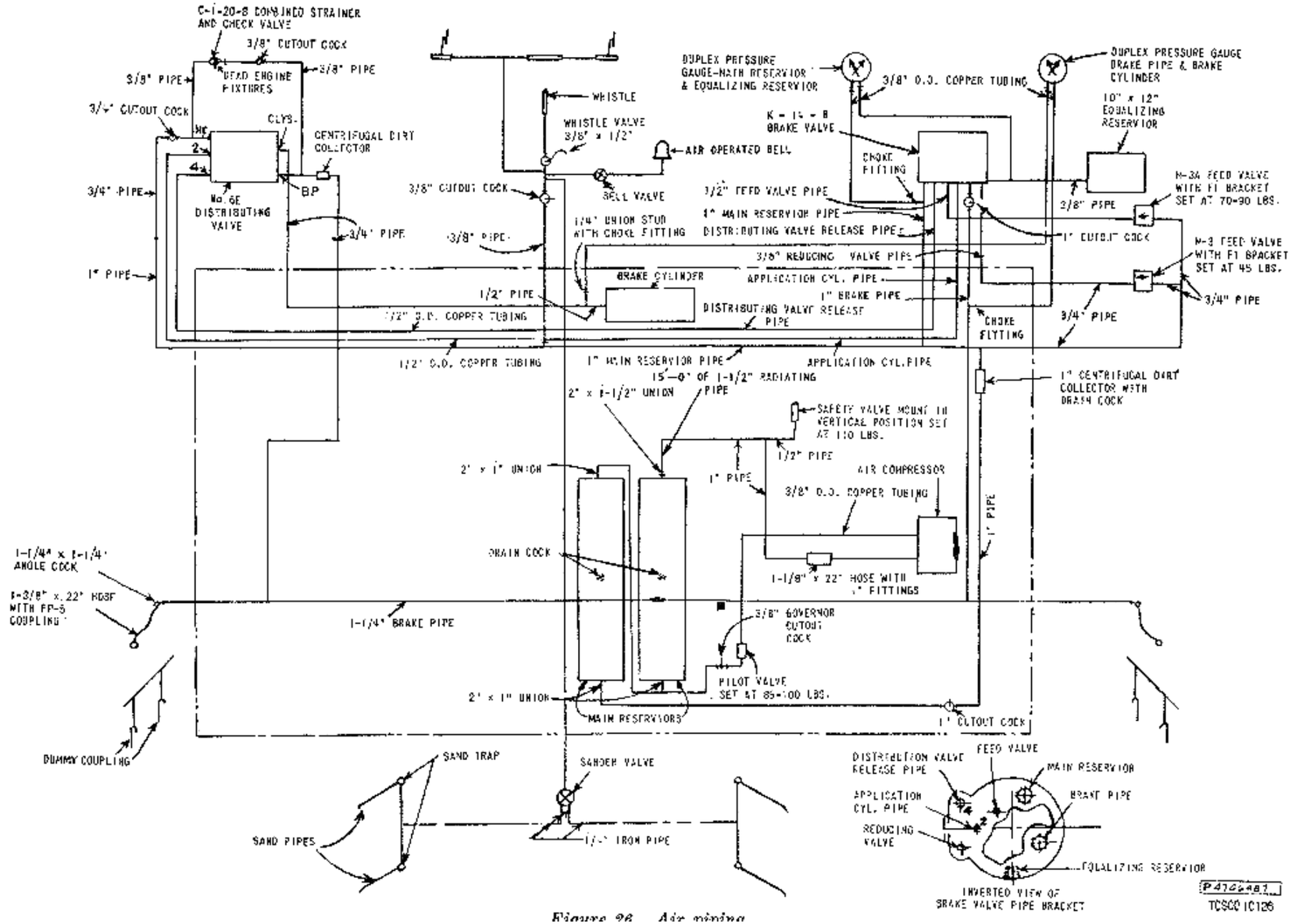


Figure 26. Air piping.

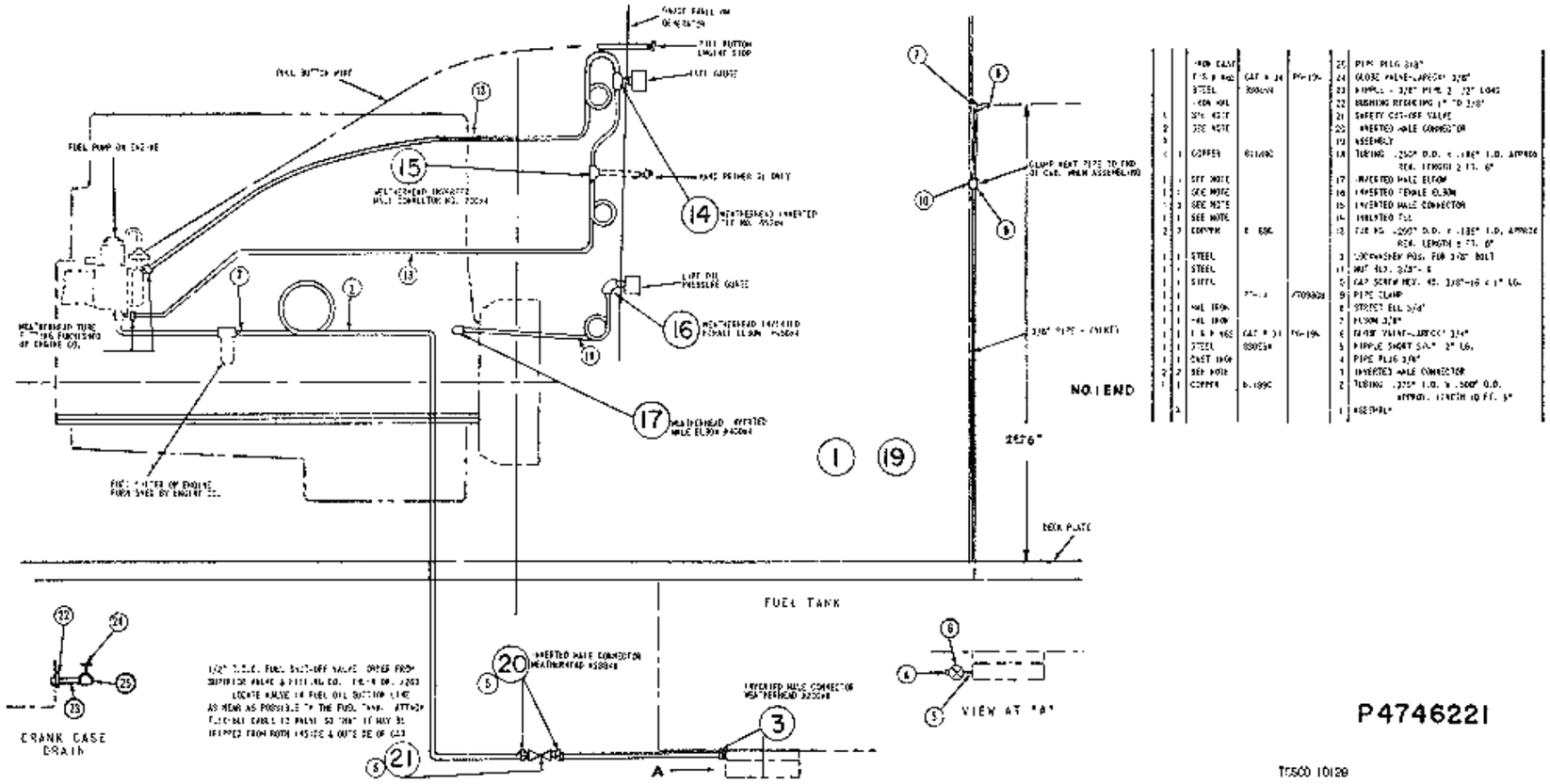


Figure 27. Fuel oil piping.

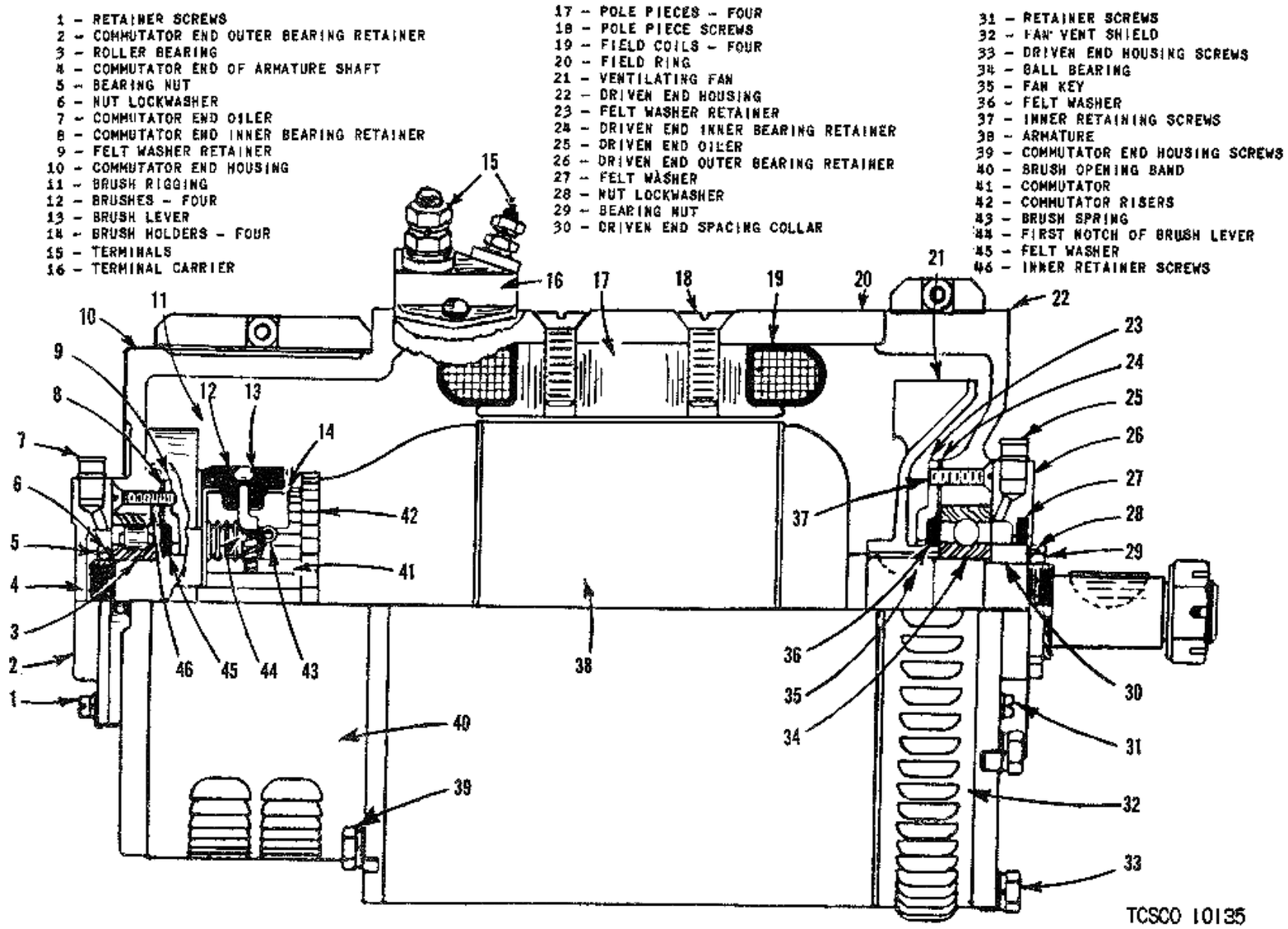
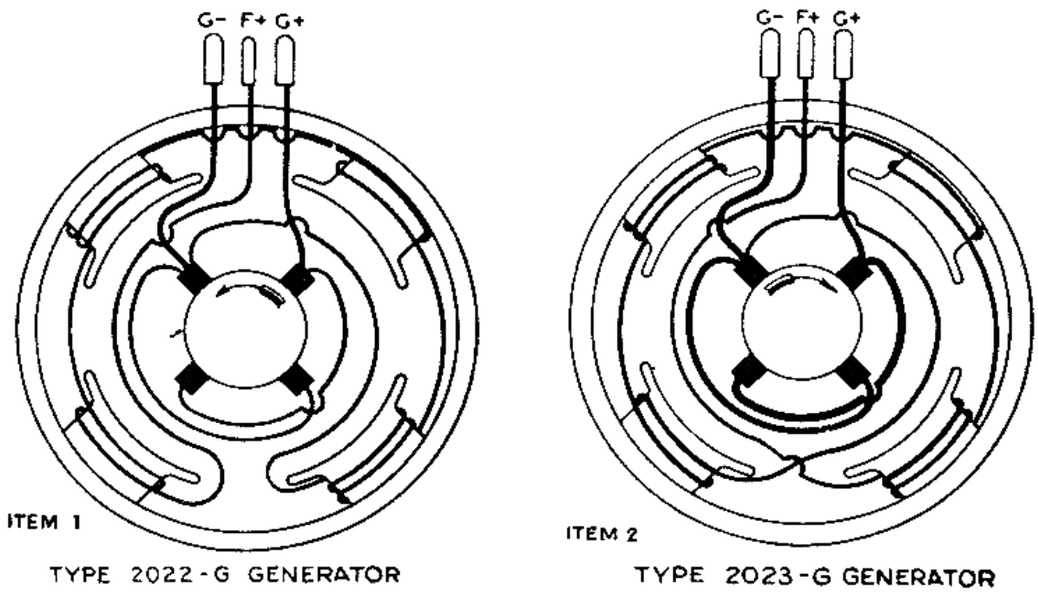


Figure 28. Longitudinal section of generator, type 2023-G or 2022-G.



INTERNAL CONNECTION DIAGRAM
LOOKING AT COMMUTATOR ENDTCSCO 10120

Figure 29. Internal connection diagram, type 2022-G or 2023-G generator.

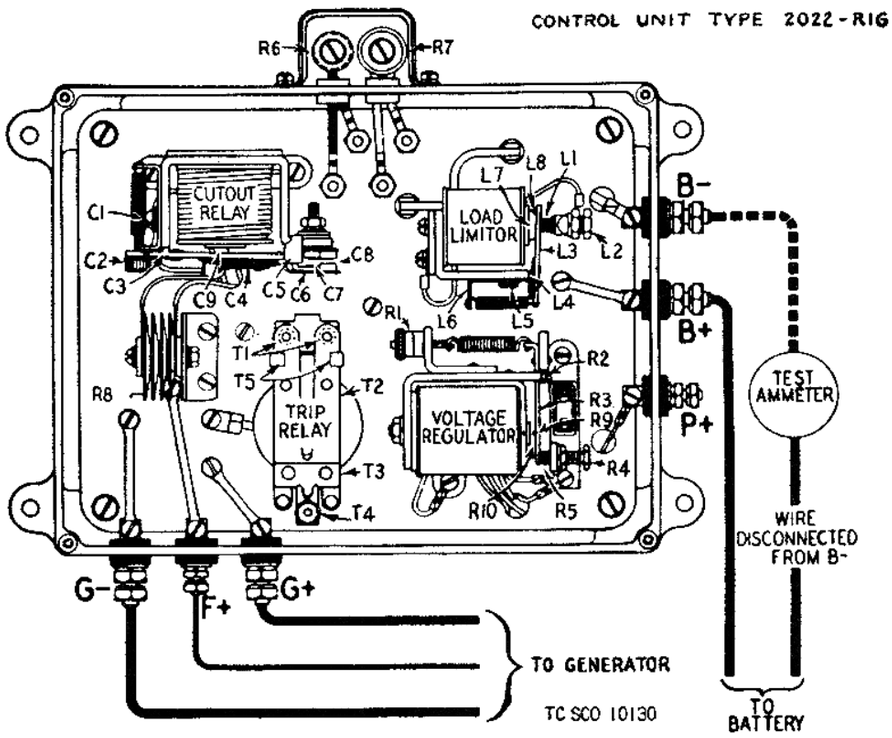


Figure 30. Control unit connections, type 2022-R16.

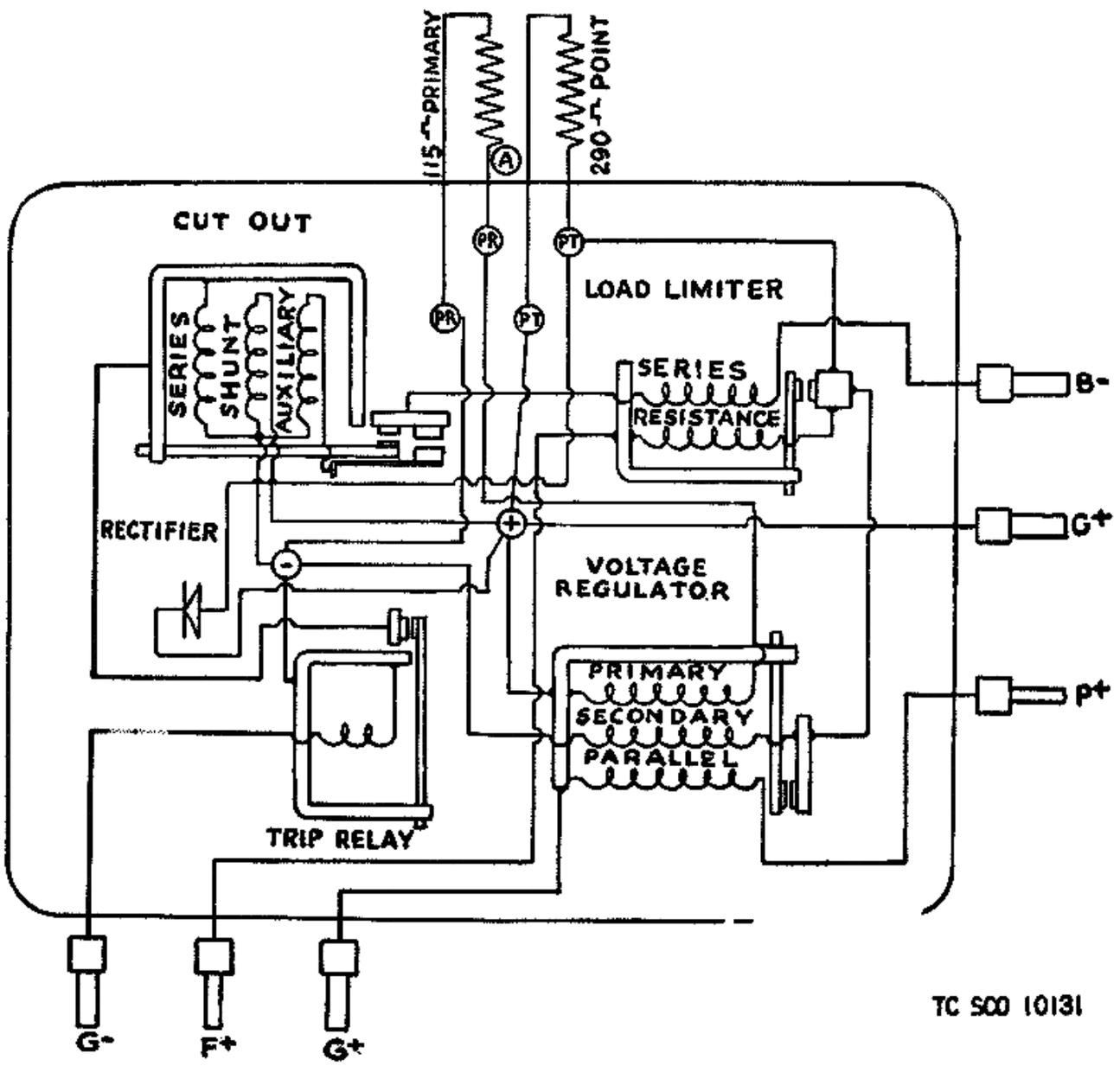


Figure 31. Internal connections, type 2022-R16 control unit.

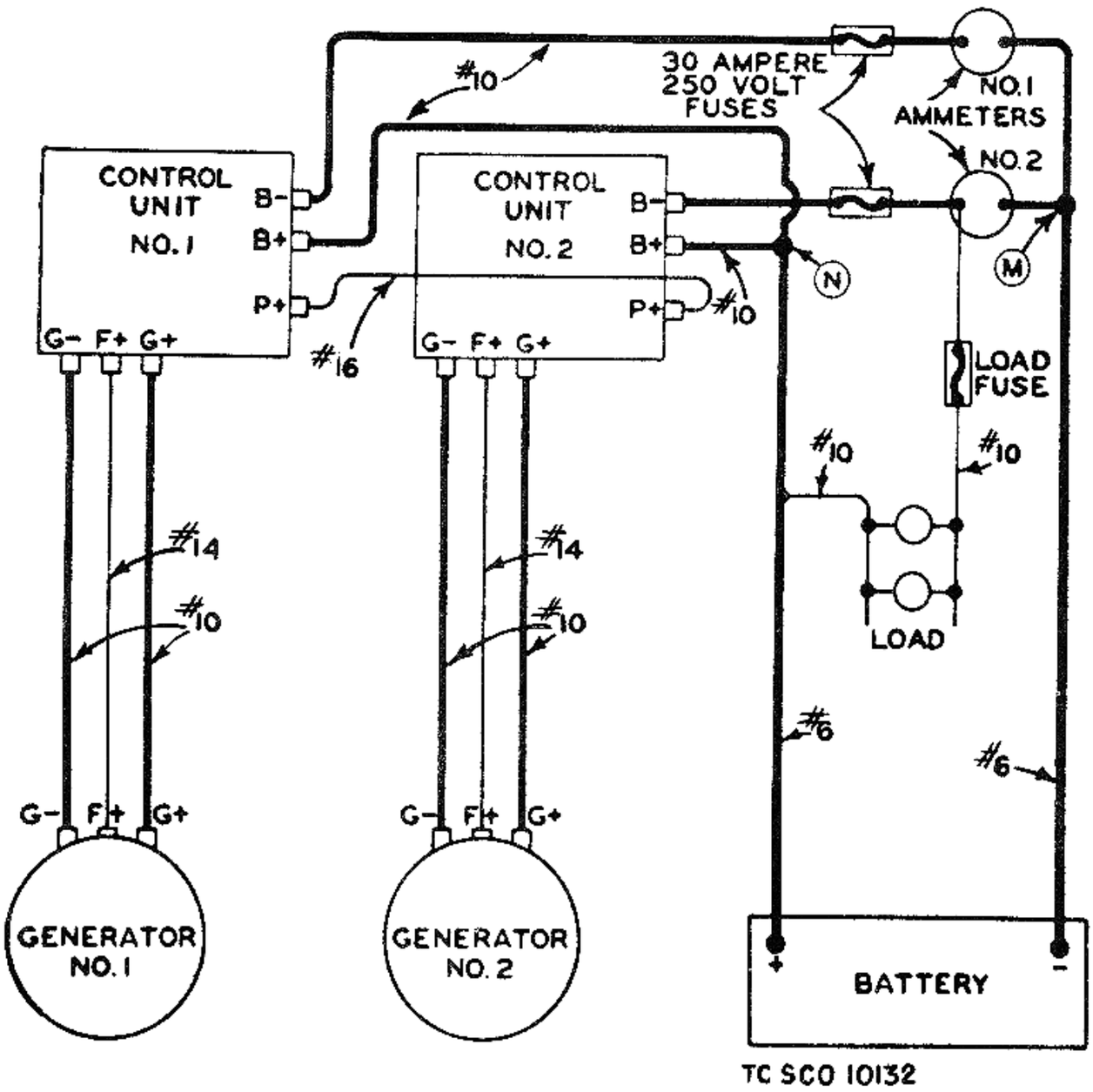


Figure 32. Test connection diagram.

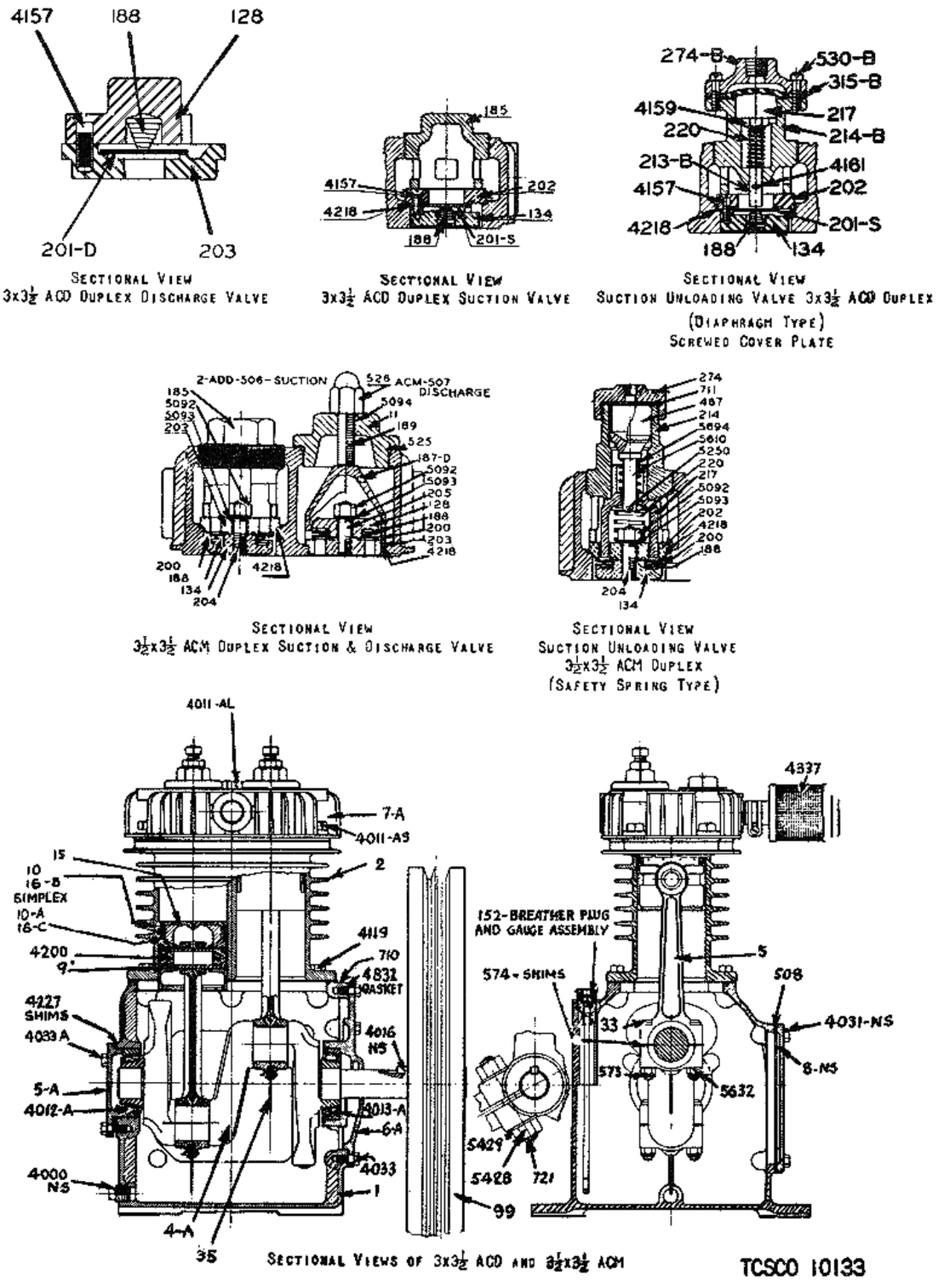


Figure 33. Sectional views 3 x 3 1/2 ACD, 3 1/2 x 3 1/2 ACM.

[AG 453.3 (25 Feb 53)]

BY ORDER OF THE SECRETARY OF THE ARMY

M. B. RIDGWAY,
General, United States Army,
Chief of Staff.

OFFICIAL:
WM. E. BERGIN,
Major General, United States Army,
The Adjutant General.

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NG: None.
USAR: None.

For explanation of distribution formula, see SR 310-90-1.

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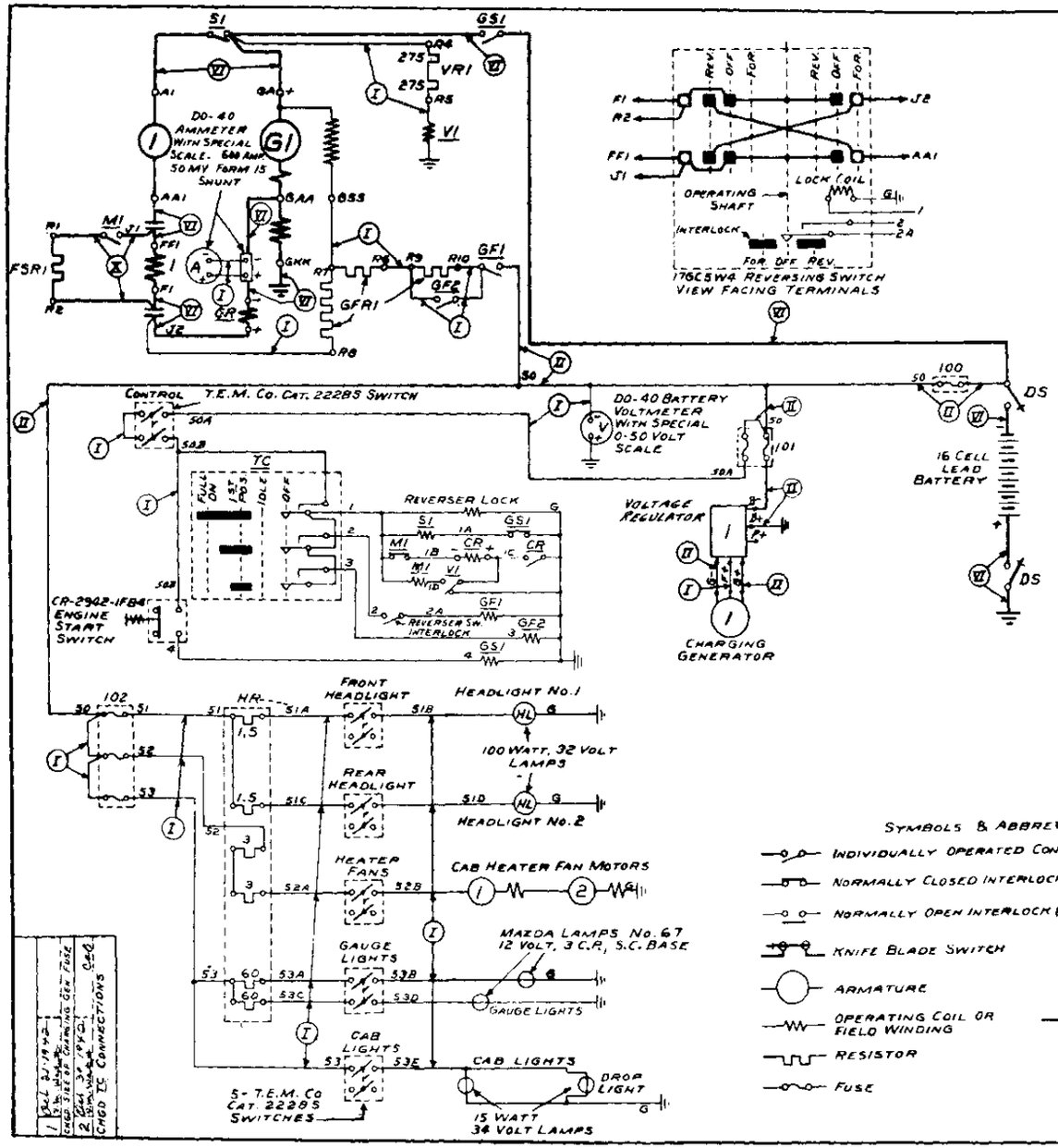

CABLE SIZES					
SYMBOL	CIRCUIT	AWG SIZE	DIAMETERS BARE	DIAMETERS MAX. OUTSIDE	SPECIFICATION
VI	MAIN GENERATOR, TRACTION MOTOR, & ENG. STARTING	450/24	.578"	.897"	SI-12250
X	FIELD SHUNTING	175/24	.360"	.648"	SI-12250
II	BATTERY CHARGING & CONTROL	37/24	.142"	.290"	SI-12250
I	CONTROL & LIGHTS	19/25	.090"	.238"	SI-12250

APPARATUS TABLE					
SYMBOL	APPARATUS	OPERATING COIL DATA CATALOG No.	OPERATING COIL DATA RES AT 25°C	INTERLOCK	REMARKS
GFI, GF2	17CM15CC29 GENERATOR FIELD CONTACTORS	2738570	73		
CR	17LS8A2 FIELD CONTROL RELAY	PICK UP COIL 4739255	71		WITH ENGINE AT FULL THROTTLE, RELAY SHOULD DROP OUT, OPENING MI, AT 18 TO 20 MPH (APPROX. AT 220-230 A. IN SERES COIL ALONE
TC	17HE8C1 THROTTLE CONTROL SWITCH				
SI	17CM12BE2 LINE CONTACTOR	2738575	38.6		
MI	17CM12LE FIELD SHUNTING CONTACTOR	2738575	38.6	17AF14H1	
GSI	17CM12J15 ENGINE STARTING CONTACTOR	2738770	6.4	17AF14H1	
VI	DB1687-C4 FIELD SHUNTING CONTROL RELAY	2738093	9.2		PICK UP 280-290 VOLTS DROPOUT 165-175 VOLTS
⊣⊢	17GC5W4 REVERSING SWITCH	LOCK COIL 2738669	117		
DS	DPST-200 AMP. 250 V BATTERY SWITCH, T.E.M. CO. CAT. 3806 WITH EBONY ASBESTOS BASE & KNOB HANDLE				
HR	17FR21A6 CONTROL RESISTOR PANEL WITH 2-1.5 OHM, 2-3.0 OHM, & 2-60 OHM QF-K-5901206-G1 RESISTOR UNITS				
FSRI	17EW101A2 FIELD SHUNTING RESISTOR PER DIAGRAM K-6724629				
VRI	17FR21B3 RESISTOR PANEL WITH 2-QFK-2673251, 275 OHM RESISTOR UNITS				
GFRI	17FR22A1 GENERATOR FIELD RESISTOR PANEL, CONNECTED PER K-6724793				

FUSE TABLE						
SYMBOL	APPARATUS	CIRCUIT	VOLTS	AMP.	CATALOG No.	QUANTITY
100	CUTOUT CAT 36803	BATTERY	250	50	GE1470	1
101	CUTOUT CAT. 34367	CHARGING GENERATOR	250	25	GE1465	1
		CONTROL	250	10	GE1461	1
102	CUTOUT CAT 34372	HEADLIGHT, GAUGE & CAB LIGHTS & HEATER FAN MOTOR	250	10	GE1461	3

SYMBOLS & ABBREVIATIONS

- INDIVIDUALLY OPERATED CONTACTOR OR RELAY
- NORMALLY CLOSED INTERLOCK (CLOSED WHEN CONTACTOR IS DE-ENERGIZED)
- NORMALLY OPEN INTERLOCK (OPEN WHEN CONTACTOR IS DE-ENERGIZED)
- KNIFE BLADE SWITCH
- ARMATURE
- OPERATING COIL OR FIELD WINDING
- RESISTOR
- FUSE
- REVERSING SWITCH CONTACTS

FOR FORWARD
HL HEADLIGHT
REV REVERSE

FOR GT-1503-S1 OR GT-1503-X1
MAIN GENERATOR CONNECTIONS (G1) SEE K 6726375

TYPE M, SINGLE END, SINGLE UNIT CONTROL

FOR 25 TON LOCOMOTIVE WITH 1-CUMMINS 150 H.P. DIESEL ENGINE, 1-GT.1503 GENERATOR, & 1-GE733-C2 MOTOR (CONNECTION DIAGRAM)

FIRST MADE FOR: STOCK (MO-290-180) 6689B

GENERAL ELECTRIC ERIE WORKS P-6742153

6689B2 2
6689B1 1

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Figure 34. Locomotive connection diagram.